United States Department of Agriculture

Natural Resources Conservation Service

In cooperation with North Dakota Agricultural Experiment Station, North Dakota Cooperative Extension Service, North Dakota State Soil Conservation Committee, North Dakota State Department of Transportation, Towner County Board of Commissioners, and the Towner County Soil Conservation District

Soil Survey of Towner County, North Dakota

The soil properties and interpretations included in this survey were current as of 1992. The most current information is available through the Natural Resources Conservation Service Soil Data Mart Website at http://soildatamart.nrcs.usda.gov/ and/or the Natural Resources Conservation Service Web Soil Survey at http://websoilsurvey.nrcs.usda.gov/app.

How to Use This Soil Survey

General Soil Map (STATSGO)

The general soil map, which is the color map preceding the detailed soil maps, shows the survey area divided into groups of associated soils called general soil map units. This map is useful in planning use and management of large areas.

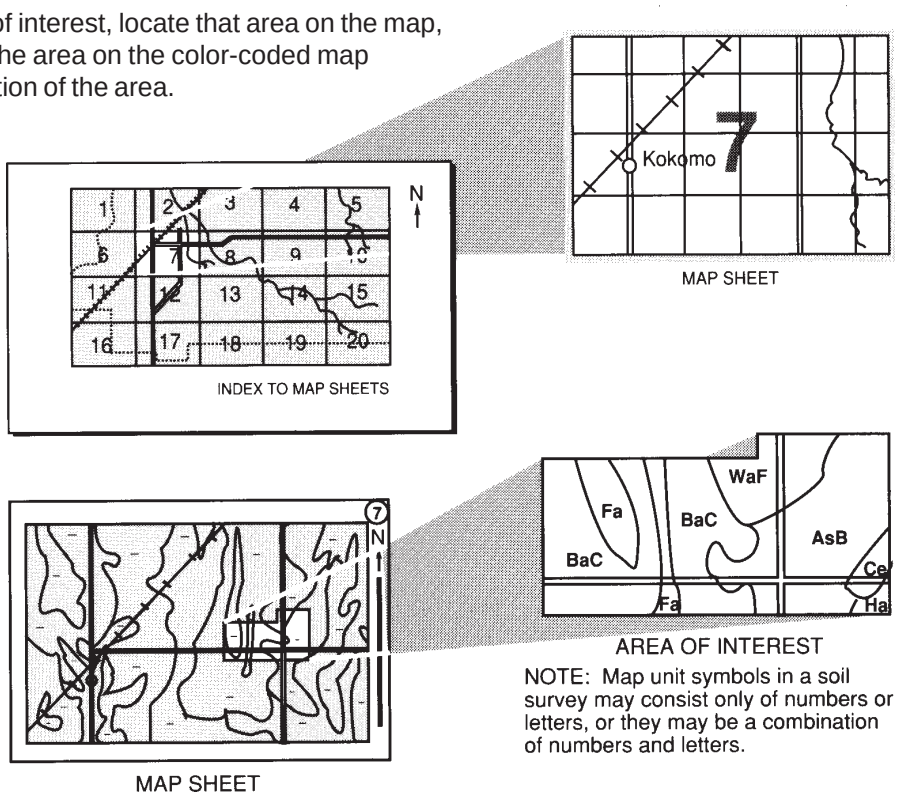
To find information about your area of interest, locate that area on the map, identify the name of the map unit in the area on the color-coded map legend, and then refer to the description of the area.

Detailed Soil Maps

The detailed soil maps are found at the back of the book. These maps can be useful in planning the use and management of small areas.

To find information about your area of interest, locate that area on the **Index to Map Sheets**, which precedes the soil maps. Note the number of the map sheet and turn to that sheet.

Locate your area of interest on the map sheet. Note the map units symbols that are in that area. Turn to the **Contents**, which lists the map units by symbol and name and shows the page where each map unit is described.



The **Contents** shows which table has data on a specific land use for each detailed soil map unit. Also see the **Contents** for sections of this publication that may address your specific needs.

For additional information concerning the use of soil surveys refer to North Dakota State University Extension Service Bulletin 60, “Soil Survey: The Foundation for Productive Natural Resource Management,” (Seelig, 1993) and to the USDA-NRCS publication “From the Surface Down: An Introduction to Soil Surveys for Agronomical Use,” (Broderson, 1991).

This soil survey is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other federal agencies, state agencies, including the Agricultural Experiment Station, and local agencies. The Natural Resources Conservation Service (formerly the Soil Conservation Service) has leadership for the federal part of the National Cooperative Soil Survey.

Major fieldwork for this soil survey was completed in 1992. Soil names and descriptions were approved in 1992. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1987 to 1992. This survey was made cooperatively by the Natural Resources Conservation Service, the North Dakota Agricultural Experiment Station, North Dakota Cooperative Extension Service, and North Dakota State Soil Conservation Committee. It is part of the technical assistance furnished to the Towner County Soil Conservation District. Financial assistance was provided by the Towner County Board of Commissioners.

Soil maps in this survey may be copied without permission. Enlargement of these maps, however, could cause misunderstanding of the detail of mapping. Maps may not show the small areas of contrasting soils that could have been shown at a larger scale.

Cover: An area of Hamerly-Barnes-Tonka association. The multi-row windbreaks surrounding the farmstead provide protection from winter winds. The upper left portion of the picture shows an area of Hamerly-Tonka-Parnell complex, 0 to 3 percent slopes, within this association.

Contents

Issued 1998

Foreword

This soil survey contains information that can be used in land-planning programs in Towner County. It contains predictions of soil behavior for selected land uses. The survey also highlights limitations and hazards inherent in the soil, improvements needed to overcome the limitations, and the impact of selected land uses on the environment.

This soil survey is designed for many different users. Farmers, ranchers, foresters, and agronomists can use it to evaluate the potential of the soil and the management needed for maximum food and fiber production. Planners, community officials, engineers, developers, builders, and home buyers can use the survey to plan land use, select sites for construction, and identify special practices needed to ensure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the survey to help them understand, protect, and enhance the environment.

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are shallow to bedrock. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

These and many other soil properties that affect land use are described in this soil survey. Broad areas of soils are shown on the STATSGO general soil map. The location of each soil is shown on the detailed soil maps. Each soil in the survey area is described. Information on specific uses is given for each soil. Help in using this publication and additional information are available at the local office of the Natural Resources Conservation Service or the Cooperative Extension Service.

Scott Hoag, Jr.
State Conservationist
Natural Resources Conservation Service

Where to Get Updated Information

The soil properties and interpretations included in this survey were current as of 1992. The most current information is available through the Natural Resources Conservation Service Soil Data Mart Website at http://soildatamart.nrcs.usda.gov/ and/or the Natural Resources Conservation Service Web Soil Survey at http://websoilsurvey.nrcs.usda.gov/app.

Additional information is available from the Natural Resources Conservation Service Field Office Technical Guide in Cando, North Dakota, or online at www.nrcs.usda.gov/technical/efotg. The data in the Field Office Technical Guide are updated periodically.

Additional information about soils and about NRCS is available through the North Dakota NRCS Web page at www.nd.nrcs.usda.gov.

For further information please contact:

USDA-Natural Resources Conservation Service
Cando Field Office
1200 Highway 281 South
Cando, ND 58324-6100
Telephone: 701-968-4457
Fax: 701-968-3308

Soil Survey of
Towner County, North Dakota

By Soil Survey Staff, Natural Resources Conservation Service

Fieldwork by Richard Lee, Robert Lisante, Earnest Jensen, David Belz, Paul Belzer, Lynn DesLauriers, Ronald Luethe, Aileen Steinolfson-Luethe, Mark Morrison, Melvin Simmons, Todd Soukup, and Paul Wellman, Natural Resources Conservation Service; and Francis Wilhelm, professional soil classifier and Stoneman-Landers Inc., soil survey contractor.

Map finishing by the North Dakota State Soil Conservation Committee.

United States Department of Agriculture, Natural Resources Conservation Service, in cooperation with
North Dakota Agricultural Experiment Station, North Dakota Cooperative Extension Service, North Dakota State Soil Conservation Committee, North Dakota State Department of Transportation, Towner County Board of Commissioners, and the Towner County Soil Conservation District.

General Nature of the Survey Area

Towner County is in the northeastern part of North Dakota (fig. 1). The county has a total area of 666,600 acres, or 1,042 square miles. It has 3,900 acres of water in bodies of more than 40 acres in size. The county seat and largest town is Cando.

This is the first published soil survey of Towner County. A general soil map of the county was published in 1968 (Patterson, et al. 1968). The present survey provides additional information, large scale maps, and shows the soils in more detail.

History

The first recorded settlements in the area were established in the 1880s. Additional information concerning the history and development of Towner County has been published by Putman (1989), Dennison, et al., (1984), and the Diamond Jubilee Committee (1959).

Physiography, Relief, and Drainage

The county is part of the Northern Black Glaciated Plains of the Northern Great Plains Spring Wheat Region (USDA-SCS, 1981). Nearly all of Towner County lies within the physiographic district of the Drift Prairie. Elevation in the county ranges from 1,775 feet in the northwestern part to less than 1,450 feet in the southeastern part of the county (Bluemle, 1984).

The county is within the Souris-Red River Basin. There are two major watersheds in the county. The area north of the town of Rock Lake drains into Canada. The remainder of the county drains into Mauvais Coulee and south into Devils Lake.

Land Uses

Farming and ranching are the main economic enterprises. The principal crops are durum wheat, spring wheat, potatoes, sunflower, flax, barley, and

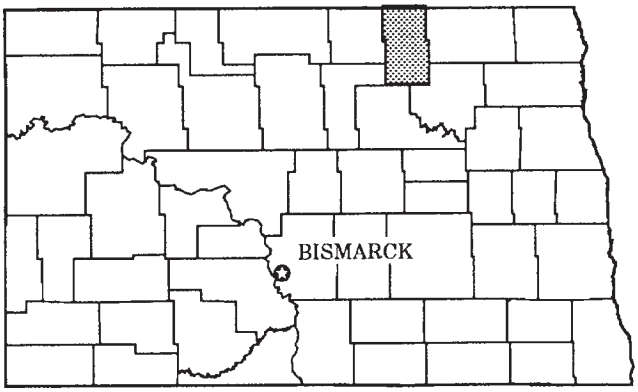


Figure 1. Location of Towner County in North Dakota.

hay (Beard and Hamlin, 1996). The Towner County Soil Conservation District was organized in 1947.

About 94 percent of the area is cropland, and 6 percent is rangeland, hayland, or other land (USDA-NRCS, 1992). Irrigation is limited to a small area underlain by aquifers. Additional information concerning the groundwater resources in Towner County has been compiled by Randich and Kuznair (1984).

The soils in the county are mostly very deep and well suited to cropland, except the hilly to steep soils which are best suited to rangeland or pastureland. The soil parent material is mostly of glacial origin, with significant areas of glaciolacustrine, till, and glaciofluvial deposits. Many of the soils are susceptible to wind or water erosion. A significant acreage of soils are wet and ponded and produce or have produced habitat for wetland wildlife.

Climate

The climate of Towner County is subhumid. The area is usually quite warm in summer with frequent spells of hot weather and occasional cool days. It is very cold in winter, when arctic air frequently surges over the area. Most precipitation falls in late spring and early summer.

Table 1, "Temperature and Precipitation," gives data on temperature and precipitation for the survey area as recorded at Leeds, North Dakota, in the period 1961 to 1990. Table 2, "Freeze Dates in Spring and Fall," shows probable dates of the first freeze in fall and the last freeze in spring. Table 3, "Growing Season," provides data on length of the growing season.

In January, the average temperature is 4 degrees F, and the average daily minimum temperature is -6 degrees F. In July, the average temperature is 68 degrees F, and the average daily maximum temperature is 81 degrees F.

Growing degree days are shown in Table 1. They are equivalent to "heat units." During the month, growing degree days accumulate by the amount the average temperature each day exceeds a base temperature (40 degrees F). The normal monthly accumulation is used to schedule single or successive plantings of a crop between the last freeze in spring and the first freeze in fall.

The average annual total precipitation in the county is about 17 inches. Of this, about 13 inches, or 75 percent, usually falls in April through September. The growing season for most crops falls within this period. In 2 years out of 10, the rainfall in April through September is less than 6.5 inches or more than 18.5 inches.

Average annual snowfall is 38 inches. The average afternoon relative humidity in July is 53 percent. The sun shines a high of 71 percent of the possible time in July and 44 percent of the time in November. The sun shines an average of 59 percent of the possible time annually. The prevailing wind is from the northwest. The average annual windspeed is 12.9 miles per hour (Jensen, 1972).

How This Survey Was Made

This survey was made to provide information about the soils and miscellaneous areas in the survey area. The information includes a description of the soils and miscellaneous areas and a discussion of the suitability, limitations, and management of the soils and miscellaneous areas for specified uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They dug many holes to study the soil profile, which is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down to the unconsolidated material in which the soil formed. The unconsolidated material is devoid of roots and other living organisms and has not been changed by biological activity.

Soils and miscellaneous areas in the survey area are in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind or segment of the landscape. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landscape, soil scientists

develop a concept, or model, of how the soils were formed. Thus, during mapping, this model enables soil scientists to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Individual soils on the landscape commonly merge into one another as their characteristics gradually change. To construct an accurate map, however, soil scientists must determine boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationships, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded characteristics of the soil profiles they studied. They noted color, texture, size, and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, soil reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison and to classify soils systematically. Soil Taxonomy (Soil Survey Staff, 1975), the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After soil scientists classified and named the soils in the survey area, they compared individual soils with similar soils in the same taxonomic class in other areas so they could confirm data and assemble additional data based on experience and research.

While a soil survey is in progress, samples of some of the soils in the area are collected for laboratory analyses and for engineering tests. Soil scientists interpret data from these analyses and tests as well as field-observed characteristics and soil properties to determine expected behavior of soils under different uses. Interpretations for the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations may be developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

The descriptions, names, and delineations of the soils in this survey area do not fully agree with those of the soils in adjacent survey areas. Differences are the result of a better knowledge of soils, modifications in series concepts, or variations in the intensity of mapping or in the extent of the soils in the survey areas.

Survey Procedures

The general procedures used to make this survey are described in the National Soil Survey Handbook (Soil Survey Staff, 1996b) and the Soil Survey Manual (Soil Survey Staff, 1993. The Major Soils of North Dakota (Omodt, et al., 1968), Soil Taxonomy (Soil Survey Staff 1975), and Land Resource Regions and Major Land Resource Areas of the United States (USDA-SCS 1981), were among the references used. The procedures used in determining the nature and characteristics of the soils are described under the heading “How This Survey Was Made.”

All soil mapping was done on field sheets developed from high-altitude black and white aerial photographs from the National High Altitude Photography (NHAP) Program. The scale of the field sheets was 1:24,000 or 2.64 inches to the mile. Detail of these field sheets was checked with older aerial photography, color infrared photography, and in some instances, topographic maps. The soil maps are published on full quadrangle orthophotography.

Soil delineations were drawn on field sheets by traversing the land on foot, by pickup with mounted hydraulic soil probe, or by all-terrain vehicle. Traverses were planned to cross all major landforms

and were at intervals close enough to locate contrasting soil areas of about 3 to 5 acres. Soils were examined to a depth of 3 to 5 feet, depending on the kind of soil. Soil properties, including color, texture, structure, horizonation, and presence of salts and stones were examined.

All map units were characterized for soil variability by transecting representative areas. A transect is a series of detailed soil examinations done in a map unit delineation to determine the range of composition of various kinds of soil and soil properties. One transect was required for each 1,000 acres of the unit mapped.

Data collected from the transects were used to determine map unit names and establish the range of composition of soil in each map unit. A statistical method was used for the analyses. This method predicts, at a 90 percent confidence level, the average composition in the county for each named map unit component and similar soil will be between the range given in the map unit description (Brubaker and Hallmark, 1991).

Each soil map unit was documented by a least one pedon description for each soil series identified in its name. Soil pedons were sampled for soil characterization or engineering test data. The soil analyses were made by the Natural Resources Conservation Service's Soil Survey Laboratory at Lincoln, Nebraska and the North Dakota State Department of Transportation.

Table 1.——Temperature and Precipitation

(Recorded in the period 1961-90 at Leeds, North Dakota.)

Month	Temperature						Precipitation			
				2 years in 10 will have				2 yrs in 10 will have		
	avg daily max	avg daily min	avg	max temp. >than	min temp. <than	avg no. of growing degree days*	avg (in.)	less than (in.)	more than (in.)	average number of days with 0.10 inch or more
January	13.9	-6.2	3.8	43	-34	0	0.68	0.26	1.13	2
February	20.2	-0.4	9.9	47	-32	0	0.44	0.18	0.75	1
March	32.8	12.6	22.7	62	-23	9	0.92	0.34	1.40	2
April	51.4	28.5	40.0	84	3	118	1.49	0.61	2.42	3
May	66.9	40.3	53.6	91	20	415	2.02	0.89	3.00	5
June	76.0	50.6	63.3	96	33	650	2.82	1.50	3.98	5
July	81.4	55.1	68.3	98	40	847	2.72	1.35	3.91	5
August	80.5	51.9	66.2	99	35	782	2.02	0.96	2.93	4
September	68.1	41.9	55.0	95	21	432	1.78	0.65	2.71	4
October	55.5	31.3	43.4	83	11	173	1.13	0.34	1.85	2
November	34.8	15.9	25.4	66	-14	12	0.62	0.22	1.08	2
December	18.7	-0.5	9.1	47	-31	0	0.59	0.21	0.90	1
Yearly :										
Average	50.0	26.8	38.4	----	----	----	---	---	---	---
Extreme	105	-39	---	104	-36	----	---	---	---	---
Total	---	---	---	----	----	3,439	17.23	12.50	20.20	36

* A growing degree day is a unit of heat available for plant growth. It can be calculated by adding the maximum and minimum daily temperatures, dividing the sum by 2, and subtracting the temperature below which growth is minimal for the principal crops in the area (Threshold: 40.0 deg. F)

Table 2.——Freeze Dates in Spring and Fall

(Recorded in the period 1961-90 at Leeds, North Dakota.)

Probability	Temperature		
	24F or lower	28F or lower	32F or lower
Last freezing temperature in spring :			
1 year in 10 later than--	May 14	May 27	June 6
2 year in 10 later than--	May 8	May 21	May 31
5 year in 10 later than--	April 25	May 10	May 19
First freezing temperature in fall :			
1 yr in 10 earlier than--	September 23	September 14	August 27
2 yr in 10 earlier than--	September 28	September 19	September 2
5 yr in 10 earlier than--	October 9	September 29	September 15

Table 3.——Growing Season

(Recorded in the period 1961-90 at Leeds, North Dakota.)

Probability	Daily Minimum Temperature		
	# days > 24F	# days > 28F	# days > 32F
9 years in 10	127	109	88
8 years in 10	136	118	98
5 years in 10	153	135	117
2 years in 10	169	151	136
1 year in 10	178	160	146

General Soil Map Units (STATSGO)

The general soil map at the back of this publication was derived from STATSGO (State Soil Geographic Data Base). STATSGO (USDA-SCS, 1990) is a small scale digital general soil map of North Dakota and an accompanying data base. It shows broad areas that have a distinctive pattern of soils, relief, and drainage. These similar areas are delineated into general soil map units or soil associations. Each soil association is a unique natural landscape. Typically, they consist of one or more major soils or components and some minor soils or components. The soils making up an association can occur in another association but in a different pattern. The STATSGO map can be used to compare the suitability of large areas for general land uses. Areas of soils suitable for a practice or use can be identified on the map. Likewise, areas that are not suitable can be identified. Broad interpretive groupings can be developed using STATSGO data. STATSGO maps are designed to be used primarily for multi-county and state resource evaluation and planning. Interpretive tables and maps can be prepared for North Dakota, or for smaller areas within the state. STATSGO maps can be used as part of a geographic information system (GIS).

The STATSGO map was compiled by generalizing more detailed soil survey maps. Information on the geology, topography, vegetation, and climate was also considered in the development of this map. The data base contains information on each association's acreage and composition. It also contains soil properties and interpretive data.

Maps were compiled at a scale of 1:250,000 (1 inch equals 4 miles). The smallest delineations are about 1,500 acres in size. STATSGO maps are prepared nationwide at the same scale and join across county and state boundaries. The maps meet national standards for mapping conventions and scale. Because of its small scale, the map is not suitable for planning the management of a farm or field or for selecting a site for a road or building. The soils in any one association differ from place to place in slope, depth, drainage, and other characteristics that affect management.

Descriptions for STATSGO associations in Towner County begin on page 9. The composition of the named components in the association description includes soils that are similar in properties and behavioral patterns. Not all minor components are listed.

The North Dakota STATSGO map and data base are maintained by the USDA-NRCS Soils Section in Bismarck, North Dakota. For more information on the use of STATSGO, or on the availability of interpretive tables and maps, contact the state NRCS office.

5—Overly-Bearden-Great Bend Association, level to undulating

	SURFACE TEXTURE*	SLOPE PERCENT	DRAINAGE**	PERCENT COMPOSITION
MAJOR COMPONENTS				
Overly	SIL	0-3	MW	35-40
Bearden	SIL	0-3	SP	25-30
Great Bend	SIL	0-6	W	5-10
MINOR COMPONENTS				
Lamoure	SICL	0-1	P	5-10
Zell	SIL	3-9	W	1-5
Hegne	SIC	0-1	P	1-5
Embden	FSL	0-6	MW	1-5

* FSL, fine sandy loam; SIL, silt loam; SICL, silty clay loam; SIC, silty clay
** P, poor; SP, somewhat poor; MW, moderately well; W, well

Description

These soil areas occur on lake plains with level to gently undulating topography. The dominant soils are medium textured. Some poorly drained depressions and swales exist in the area (fig. 2). Most areas of this association are used for cultivated crops.

Overly soils occur on broad, slightly elevated sites and Bearden soils are on nearly level to slightly depressed flats. Great Bend soils occur on gently convex positions and rises. Lamoure and Hegne soils occur in depressions, swales, and along drainageways. Zell soils occur on convex slopes of knolls and ridges. Embden soils are associated with the Overly soils on gentle rises. Bearden, Zell, and Hegne soils have a prominent high lime layer which occurs within plow depth on many of the gentle rises and lower slopes. This light-colored, limy material often is exposed and mixed with dark surface soil by cultivation, producing a pattern of black and gray over the field.

Major Limitations for Agricultural Use

These areas have few limitations for agriculture. The somewhat poorly and poorly drained soils generally have periods of wetness and ponding in the spring and after heavy rainfall. Wind erosion is a concern on some soils. For additional information concerning these soils see “Detailed Map Unit Descriptions” and “Series Descriptions.” For information concerning the limitations and hazards for agriculture see “Cropland Limitations and Management.”

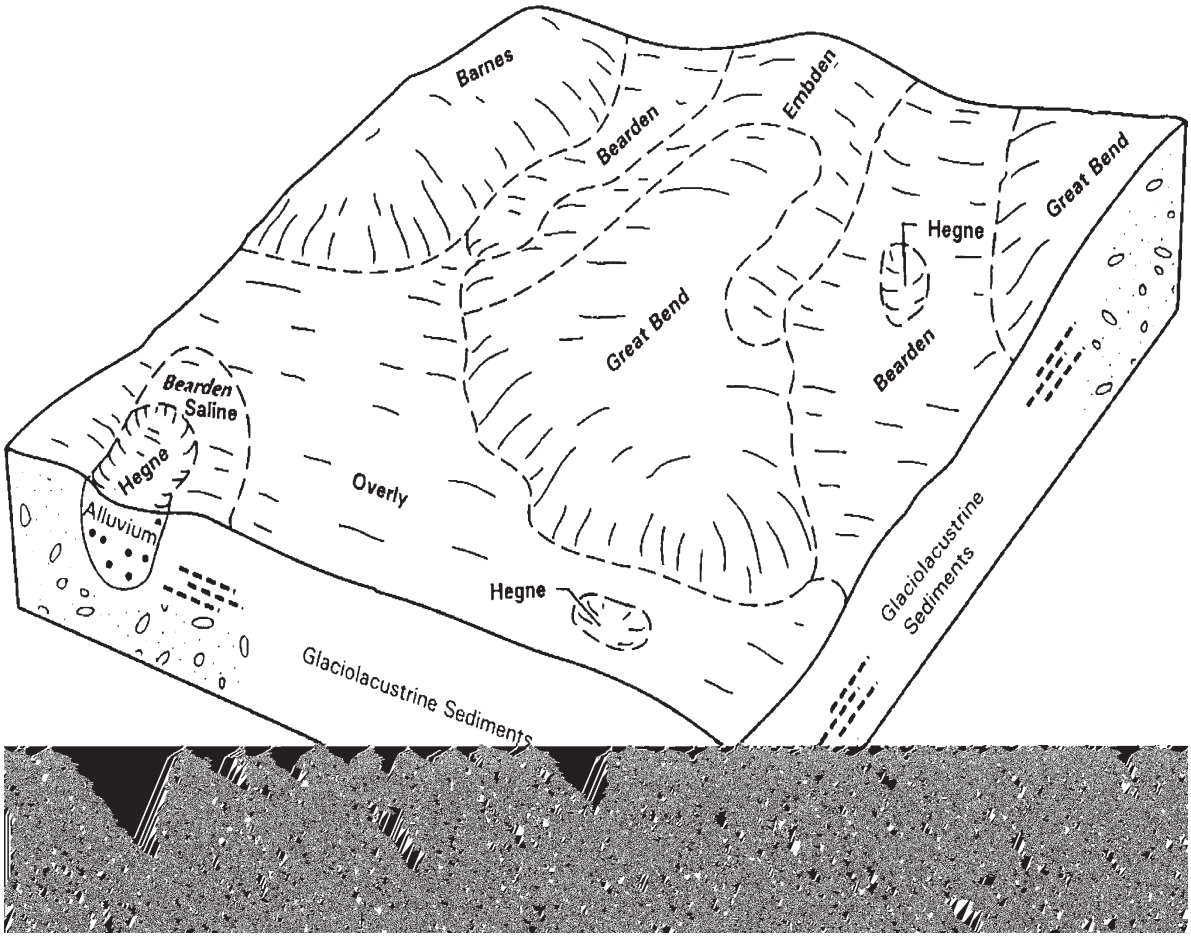


Figure 2. Typical pattern of the soils and underlying material in the Overly-Bearden-Great Bend association.

8—Bearden-Perella-Fargo Association, level and nearly level

	SURFACE TEXTURE*	SLOPE PERCENT	DRAINAGE**	PERCENT COMPOSITION
MAJOR COMPONENTS				
Bearden	SIL	0-3	SP	60-65
Perella	SIL	0-1	P	10-15
Fargo	SIC	0-1	P	5-10
MINOR COMPONENTS				
Overly	SIL	0-3	MW	5-10
Great Bend	SIL	0-3	W	1-5
Hegne	SIC	0-1	P	1-5
Colvin	SIL	0-1	P	1-5

* SIL, silt loam; SIC, silty clay
** P, poor; SP, somewhat poor; MW, moderately well; W, well

Description

These soil areas are level and nearly level with many low, elongated rises and narrow, poorly drained depressions. The dominant soils are medium and fine textured lacustrine deposits. Most areas of this association are used for cultivated crops.

Bearden soils dominate flats and low rises. Perella, Colvin, and Hegne soils occur in the swales and depressions. The fine textured Fargo soils occur on flats and in depressions. Overly soils occur on broad, slightly elevated sites. Great Bend soils occur on gently convex positions and rises. The Bearden, Colvin, and Hegne soils have a prominent high lime layer which occurs within plow depth on many of the gentle rises and lower slopes. This light-colored, limy material often is exposed and mixed with dark surface soil by cultivation, producing a pattern of black and gray over the field.

Major Limitations for Agricultural Use

Poor surface drainage and wetness are the main limitations for agriculture. Wind erosion is a concern on some soils. For additional information concerning these soils see “Detailed Map Unit Descriptions” and “Series Descriptions.” For information concerning the limitations and hazards for agriculture see “Cropland Limitations and Management.”

28—Binford-Coe-Brantford Association, level to gently rolling

	SURFACE TEXTURE*	SLOPE PERCENT	DRAINAGE**	PERCENT COMPOSITION
MAJOR COMPONENTS				
Binford	SL	1-9	SE	25-30
Coe	SL	1-9	E	20-25
Brantford	L	0-6	W	10-15
MINOR COMPONENTS				
Divide	L	0-3	SP	5-10
Kensal	L	0-3	MW	5-10
Colvin	SIL	0-1	P	1-5
Southam	SICL	0-1	VP	1-5

* SL, sandy loam; L, loam; SIL, silt loam; SICL, silty clay loam.

** VP, very poor; P, poor; SP, somewhat poor; MW, moderately well; W, well; SE, somewhat excessive; E, excessive.

.

Description

These soil areas consist of level to gently rolling topography with knolls, elongated ridges, and occasional depressions. The dominant soils are on moderately coarse and medium textured shaly outwash. Most areas of this association are used for cultivated crops.

Binford and Brantford soils occur on flats, gently sloping side slopes and broad, convex crests of knolls and ridges. Shallow Coe soils occur on crests of knolls and ridges and on shoulder slopes surrounding depressions. Kensal soils occur on concave side slopes, foot slopes, and swales. Divide soils occur on gently convex positions and flats adjacent to depressions. The Binford, Brantford, Coe, Divide, and Kensal soils are underlain by layers of sand and gravel. Poorly drained Colvin soils occur on broad low flats adjacent to depressions and potholes. Very poorly drained Southam soils occur in depressionsand potholes.

Major Limitations for Agricultural Use

Many of these soils have limited water holding capacity and may be droughty. Wind erosion may be a hazard. Some areas may have periods of wetness and ponding in the spring and after heavy rainfall. For additional information concerning these soils see “Detailed Map Unit Descriptions” and “Series Descriptions.” For information concerning the limitations and hazards for agriculture see “Cropland Limitations and Management.”

40—Hamerly-Barnes-Tonka Association, level to gently rolling

	SURFACE TEXTURE*	SLOPE PERCENT	DRAINAGE**	PERCENT COMPOSITION
MAJOR COMPONENTS				
Hamerly	L	0-3	SP	35-40
Barnes	L	1-9	W	15-20
Tonka	SIL	0-1	P	10-15
MINOR COMPONENTS				
Svea	L	0-6	MW	5-10
Vallers	L	0-1	P	5-10
Parnell	SIL	0-1	VP	5-10
Buse	L	3-6	W	5-10

* L, loam; SIL, silt loam

** VP, very poor; P, poor; SP, somewhat poor; MW, moderately well; W, well

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DESCRIPTION

These soil areas are level to gently rolling. They consist of many low, irregularly shaped knolls with short slopes. Numerous swales, low rises, poorly drained depressions and a few prominent marshes are also present. The dominant soils are on medium textured glacial till and fine textured alluvium (fig. 3). Most areas of this association are used for cultivated crops.

Hamerly soils occur on gently convex positions adjacent to depressions and on flats. Barnes soils occur on the plane and convex side slopes of knolls and ridges. Tonka and Parnell soils occur in depressions and potholes. Svea soils are associated with the Hamerly soils on the gentle lower slopes or occur on concave side and foot slopes of knolls and ridges. Poorly drained Vallers soils occur on broad low flats adjacent to depressions and potholes. Buse soils occupy steeper prominent knolls in the area. The Hamerly, Vallers, and Buse soils have a prominent high lime layer which occurs within plow depth on many of the gentle rises and lower slopes. This light-colored, limy material often is exposed and mixed with dark surface soil by cultivation, producing a pattern of black and gray over the field.

Major Limitations for Agricultural Use

These areas generally have periods of wetness and ponding in the spring and after heavy rainfall. Wind erosion is a concern on some soils. For additional information concerning these soils see “Detailed Map Unit Descriptions” and “Series Descriptions.” For information concerning the limitations and hazards for agriculture see “Cropland Limitations and Management.”

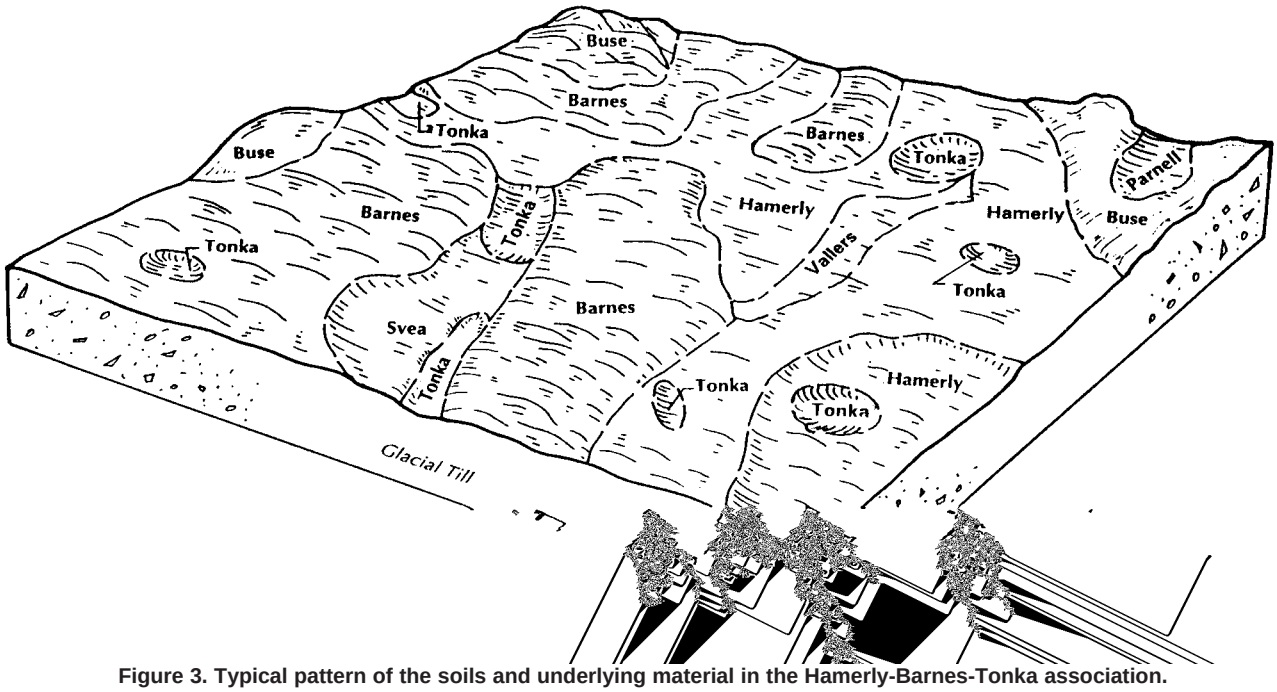

Figure 3. Typical pattern of the soils and underlying material in the Hamerly-Barnes-Tonka association.

41—Hegne-Hamerly-Fargo Association, level and nearly level

	SURFACE TEXTURE*	SLOPE PERCENT	DRAINAGE**	PERCENT COMPOSITION
MAJOR COMPONENTS				
Hegne	SIC	0-1	P	35-40
Hamerly	L	0-3	SP	20-25
Fargo	SIC	0-1	P	10-15
MINOR COMPONENTS				
Svea	L	0-6	MW	5-10
Cresbard	L	0-3	MW	5-10
Colvin	SIL	0-1	P	5-10

* L, loam; SIL, silt loam; SIC, silty clay
** P, poor; SP, somewhat poor; MW, moderately well
.

DESCRIPTION

These soil areas are level and nearly level with some very gentle rises and occasional depressions. The dominant soils are fine textured lacustrine deposits and medium textured glacial till. Most areas of this association are used for cultivated crops.

Hegne and Hamerly soils occur on flats and gently convex positions adjacent to broad swales. Fargo soils occur on broad level areas. Svea and Cresbard soils are associated with the Hamerly soils on the gentle lower slopes or occur on concave side slopes and foot slopes. Cresbard soils have a root limiting layer. Poorly drained Colvin soils occur on broad low flats adjacent to depressions. The Hegne, Hamerly, and Colvin soils have a prominent high lime layer which occurs within plow depth on many of the gentle rises. This light-colored, limy material often is exposed and mixed with dark surface soil by cultivation, producing a pattern of black and gray over the field.

Major Limitations for Agricultural Use

These areas generally have wetness and ponding in the spring and after heavy rainfall. Wind erosion is a concern on much of the area. For additional information concerning these soils see “Detailed Map Unit Descriptions”and “Series Descriptions.” For information concerning the limitations and hazards for agriculture, see “Cropland Limitations and Management.”

46—Barnes-Svea-Hamerly Association, level to gently rolling

	SURFACE TEXTURE*	SLOPE PERCENT	DRAINAGE**	PERCENT COMPOSITION
MAJOR COMPONENTS				
Barnes	L	1-9	W	40-45
Svea	L	0-6	MW	20-25
Hamerly	L	0-3	SP	10-15
MINOR COMPONENTS				
Buse	L	3-9	W	10-15
Vallers	L	0-1	P	1-5
Tonka	SIL	0-1	P	1-5
Parnell	SICL	0-1	VP	1-5

* L, loam; SIL, silt loam; SICL, silty clay loam

** VP, very poor; P, poor; SP, somewhat poor; MW, moderately well; W, well

.

DESCRIPTION

These soil areas consist of level to gently rolling topography with knolls, discontinuous ridges, and depressions. The dominant soils are on medium textured glacial till. Nearly all the surface runoff drains into depressions. Most areas of this association are used for cultivated crops.

Barnes soils occur on gently convex side slopes and broad, convex crests of knolls and ridges. Svea soils occur on concave side slopes, foot slopes and flats. Hamerly soils occur on gently convex positions adjacent to depressions. Buse soils occupy steeper prominent knolls in the area. Poorly drained Vallers soils occur on broad low flats adjacent to depressions and potholes. Tonka and Parnell soils occur in depressions and potholes. The Hamerly, Buse, and Vallers soils have a prominent high lime layer which occurs within plow depth on many of the gentle rises and lower slopes. This light-colored, limy material often is exposed and mixed with dark surface soil by cultivation, producing a pattern of black and gray over the field.

Major Limitations for Agricultural Use

Wind and water erosion are a concern on some soils. Portions of these areas have periods of wetness and ponding in the spring and after heavy rainfall. For additional information concerning these soils see “Detailed Map Unit Descriptions” and “Series Descriptions.” For information concerning the limitations and hazards for agriculture see “Cropland Limitations and Management.”

51—Svea-Cresbard-Hamerly Association, level and undulating

	SURFACE TEXTURE*	SLOPE PERCENT	DRAINAGE**	PERCENT COMPOSITION
MAJOR COMPONENTS				
Svea	L	0-6	MW	35-40
Cresbard	L	0-6	MW	35-40
Hamerly	L	0-3	SP	5-10
MINOR COMPONENTS				
Barnes	L	3-6	W	5-10
Fargo	SIC	0-1	P	1-5
Parnell	SICL	0-1	VP	1-5

* L, loam; SICL, silty clay loam; SIC, silty clay

** VP, very poor; P, poor; SP, somewhat poor; MW, moderately well; W, well

.

DESCRIPTION

These soil areas are level and undulating with many low, irregularly-shaped rises separated by shallow swales and a few depressions. The dominant soils are on medium to moderately fine textured glacial till. Most areas of this association are used for cultivated crops.

Svea soils occur on concave side slopes, foot slopes, and flats. Cresbard soils have root restrictive subsoils and are associated with the Svea soils on gentle side slopes and flats. Hamerly soils occur on gently convex positions adjacent to depressions and flats. Barnes soils occur on convex side slopes and broad, convex crests of knolls and ridges. The fine textured Fargo soils occur on lower lying flats. Parnell soils occur in depressions and potholes. The Hamerly soils have a prominent high lime layer which occurs within plow depth on many of the gentle rises and lower slopes.

Major Limitations for Agricultural Use

These areas have few limitations for agricultural purposes. Wind erosion is a concern on some soils. Portions of these areas have periods of wetness and ponding in the spring and after heavy rainfall. For additional information concerning these soils see “Detailed Map Unit Descriptions” and “Series Descriptions.” For information concerning the limitations and hazards for agriculture see “Cropland Limitations and Management.”

180—Divide-Brantford-Barnes Association, level and undulating

	SURFACE TEXTURE*	SLOPE PERCENT	DRAINAGE**	PERCENT COMPOSITION
MAJOR COMPONENTS				
Divide	L	0-3	SP	40-45
Brantford	L	1-6	W	10-15
Barnes	L	3-6	W	10-15
MINOR COMPONENTS				
Hamerly	L	0-3	SP	5-10
Colvin	SIL	0-1	P	5-10
Maddock	LFS	1-6	W	1-5
Wyndmere	FSL	0-3	SP	1-5

* LFS, loamy fine sand; FSL, fine sandy loam; L, loam; SIL, silt loam
** P, poor; SP, somewhat poor; W, well

.

DESCRIPTION

These soil areas consist of level and undulating topography. They have occasional swales and depressions. The dominant soils are on medium textured shaly outwash intermixed with medium textured glacial till (fig. 4). Most areas of this association are used for cultivated crops.

Divide and Wyndmere soils occur on gently convex positions and flats. Brantford soils occur on gently sloping side slopes and broad, convex crests of knolls and ridges. Barnes soils occur on gentle rises on glacial till. Divide and Brantford soils are underlain by layers of sand and gravel. Poorly drained Colvin soils occur on broad low flats adjacent to depressions and potholes. Maddock soils are coarse textured and are associated with the Brantford soils on slightly higher convex positions. Divide, Hamerly, Colvin, and Wyndmere soils have a prominent high lime layer which occurs within plow depth on many of the gentle rises and lower slopes. This light-colored, limy material often is exposed and mixed with dark surface soil by cultivation, producing a pattern of black and gray over the field.

Major Limitations for Agricultural Use

Many of these soils have limited water holding capacity and may be droughty. Wind erosion may be a hazard. Some areas may have periods of wetness and ponding in the spring and after heavy rainfall. For additional information concerning these soils see “Detailed Map Unit Descriptions” and “Series Descriptions.” For information concerning the limitations and hazards for agriculture see “Cropland Limitations and Management.”

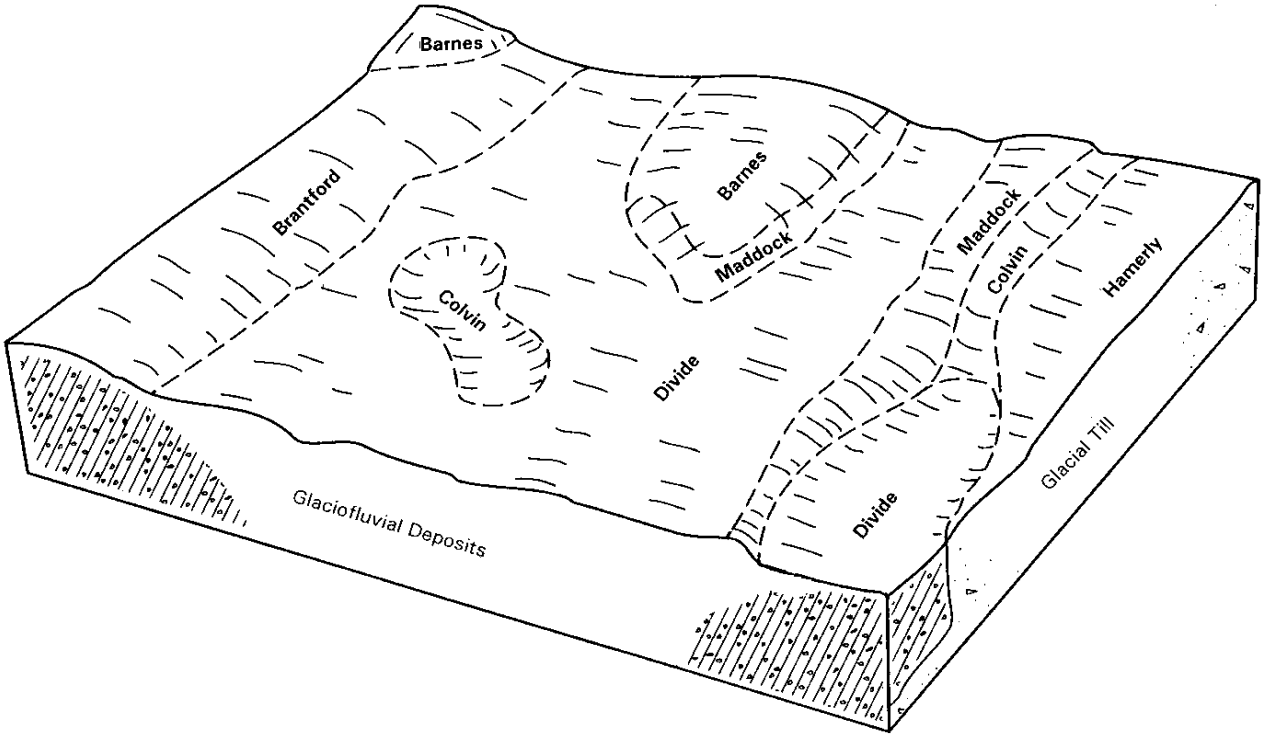

Figure 4. Typical pattern of the soils and underlying material in the Divide-Brantford-Barnes association.

181—Wyndmere-Swenoda-Hecla Association, level and undulating

	SURFACE TEXTURE*	SLOPE PERCENT	DRAINAGE**	PERCENT COMPOSITION
MAJOR COMPONENTS				
Wyndmere	FSL	0-3	SP	20-25
Swenoda	FSL	0-6	MW	20-25
Hecla	LFS	0-6	MW	10-15
MINOR COMPONENTS				
Hamerly	L	0-3	SP	5-10
Barnes	L	1-6	W	5-10
Tiffany	FSL	0-1	P	5-10
Colvin	SIL	0-1	P	1-5

* LFS, loamy fine sand; FSL, fine sandy loam; L, loam; SIL, silt loam
** P, poor; SP, somewhat poor; MW, moderately well; W, well

.

Description

These soil areas consist of level and undulating topography. They have occasional gentle rises and swales and depressions. The dominant soils are on moderately coarse and coarse textured outwash and deltaic deposits. Glacial till is in some areas. Most areas of this association are used for cultivated crops.

Wyndmere and Hamerly soils occur on nearly level and gently convex positions. Swenoda soils occur on broad slightly elevated rises. The coarse textured Hecla soils occur on flats and swales. Barnes soils occur on gentle rises of glacial till. Poorly drained Colvin soils occur on broad low flats adjacent to depressions and swales. Tiffany soils occur in shallow depressions and on low lying flats. Wyndmere, Hamerly, and Colvin soils have a prominent high lime layer which occurs within plow depth on many of the gentle rises and lower slopes. This light-colored, limy material often is exposed and mixed with dark surface soil by cultivation, producing a pattern of black and gray over the field.

Major Limitations for Agricultural Use

Early season wetness and ponding and wind erosion are the main limitations for agriculture. Some of the soils have limited water holding capacity and may be droughty. For additional information concerning these soils see “Detailed Map Unit Descriptions” and “Series Descriptions.” For information concerning the limitations and hazards for agriculture see “Cropland Limitations and Management.”

Detailed Soil Map Units

Map units on the detailed soil maps in this survey represent soils or miscellaneous areas in the survey area. The map unit descriptions in this section, along with the soil maps, can be used to determine the suitability and potential of a soil for specific uses. They also can be used to plan the management needed for those uses. More information on each map unit, or soil, is given under the heading “Use and Management of the Soils.”

A map unit delineation on the detailed soil maps represents an area on the landscape and consists of one or more soils or miscellaneous areas. The soils or miscellaneous areas are called map unit components. The map unit descriptions in this section describe the setting of the map unit or where on the landscape named map unit components can be found. The composition, or the proportion, of various soils or miscellaneous areas of a map unit determine how a map unit is named.

A map unit is identified according to the taxonomic classification of the dominant soils or miscellaneous areas. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, soils and miscellaneous areas are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some “included” areas that belong to other taxonomic classes.

Most included soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called similar soils. They may or may not be mentioned in the map unit description. Other included soils and miscellaneous areas, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting or dissimilar soils. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. Included soils or miscellaneous areas are mentioned in the map unit descriptions.

A few included areas may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of included areas in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into segments that have similar use and management requirements. The delineation of such landscape segments on the map provides sufficient information for the development of resource plans, but if intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

The map unit descriptions on the following pages give a range in composition for the named map unit components and similar soils. They also give the average composition of named, similar, and contrasting soils.

Soils that have profiles that are almost alike make up a soil series. Except for minor differences in texture of the surface layer or underlying layers, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer or of underlying layers. They also can differ in slope, stoniness, salinity, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into soil phases. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Hecla loamy fine sand, 0 to 3 percent slopes, is one of the phases of the Hecla series.

A complex consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Hamerly-Tonka-Parnell complex, 0 to 3 percent slopes, is an example.

An undifferentiated group is made up of two or more soils that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils in the mapped areas are not uniform. An area can be made up of only one of the major soils, or it can be made up of all of them. Bearden and Colvin silt loams, saline, is an undifferentiated group in this survey area.

This survey includes miscellaneous areas. Such areas have little or no soil material and support little or no vegetation. Pits, gravel and sand, is an example. Miscellaneous areas are shown on the soil maps. Some that are too small to be shown are identified by special symbols on the soil maps.

The map unit descriptions on the following pages give information on each named component. Information such as surface layer texture, depth class, and drainage class are included. There is also information concerning the management of the map unit.

An identifying symbol precedes the map unit name in each map unit description. This symbol is used to identify delineations on the soil maps.

Table 4, “Acreage and Proportionate Extent of the Soils,” gives the acreage and proportionate extent of each map unit in the survey area. Additional information about each named component and map unit inclusion can be found in “Soil Descriptions.” Other tables give properties of the soils and the limitations, capabilities, and potentials for many uses. The “Glossary” defines many of the terms used in describing the soils or miscellaneous areas.

118—Barnes-Buse loams, 3 to 6 percent slopes

Setting

Landform
- Barnes: Till plain
- Buse: Till plain

Landform component
- Barnes: Knolls
- Buse: Knolls

Map Unit Composition (percent)

Named Components
- Barnes and similar soils: 50 to 75
- Buse and similar soils: 15 to 40

Average Component Composition
- Barnes: 39
- Buse: 27
- Svea: 22
- Hamerly: 7
- Tonka: 2
- Coe: 1
- Hecla: 1
- Parnell: 1

Named Component Description

Barnes
- Surface layer texture: Loam
- Depth class: Very deep (more than 60 inches)
- Drainage class: Well drained
- Slope: 3 to 6 percent
- Position on landform: Side slopes
- Slope shape: Plane
- Flooding: None
- Notes: In some places gravel is at a depth of 32 to 40 inches. Some places may be very stony.

Buse
- Surface layer texture: Loam
- Depth class: Very deep (more than 60 inches)
- Drainage class: Well drained
- Slope: 3 to 6 percent
- Position on landform: Summits and shoulder slopes
- Slope shape: Convex
- Flooding: None
- Notes: Some places may be very stony.

Detailed soil descriptions for all map unit components are included in alphabetical order in the section, “Soil Series and Their Morphology.” Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction is available in the “Soil Properties” section.

Management

Major use: Cropland

For information about managing this map unit, see the following sections:
- Agronomy
- Engineering
- Range
- Recreation
- Soil Properties
- Wildlife Habitat

120—Barnes-Buse loams, 6 to 9 percent slopes

Setting

Landform
- Barnes: Till plain
- Buse: Till plain

Landform component
- Barnes: Ridges and knolls
- Buse: Ridges and knolls

Map Unit Composition (percent)

Named Components
- Barnes and similar soils: 35 to 60
- Buse and similar soils: 25 to 50

Average Component Composition
- Barnes: 31
- Buse: 41
- Svea: 16
- Hamerly: 6
- Coe: 3
- Binford: 1
- Swenoda: 1
- Tonka: 1

Named Component Description

Barnes
- Surface layer texture: Loam
- Depth class: Very deep (more than 60 inches)
- Drainage class: Well drained
- Slope: 6 to 9 percent
- Position on landform: Side slopes
- Slope shape: Plane
- Flooding: None
- Notes: Some places may be very stony.

Buse
- Surface layer texture: Loam
- Depth class: Very deep (more than 60 inches)
- Drainage class: Well drained
- Slope: 6 to 9 percent
- Position on landform: Summits and shoulder slopes
- Slope shape: Convex
- Flooding: None
- Notes: Some places may be very stony.

Detailed soil descriptions for all map unit components are included in alphabetical order in the section, “Soil Series and Their Morphology.” Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction is available in the “Soil Properties” section.

Management

Major use: Cropland

For information about managing this map unit, see the following sections:
- Agronomy
- Engineering
- Range
- Recreation
- Soil Properties
- Wildlife Habitat

154—Barnes-Svea loams, 0 to 3 percent slopes

Setting

Landform
- Barnes: Till plain
- Svea: Till plain

Landform component
- Barnes: Rises
- Svea: Flats and swales

Map Unit Composition (percent)

Named Components
- Barnes and similar soils: 50 to 75
- Svea and similar soils: 15 to 40

Average Component Composition
- Barnes: 55
- Svea: 27
- Hamerly: 7
- Buse: 7
- Cresbard: 1
- Tonka: 1
- Vallers: 1
- Parnell: 1

Named Component Description

Barnes
- Surface layer texture: Loam
- Depth class: Very deep (more than 60 inches)
- Drainage class: Well drained
- Slope: 0 to 3 percent
- Slope shape: Convex
- Flooding: None
- Notes: Some places may have surface stones.

Svea
- Surface layer texture: Loam
- Depth class: Very deep (more than 60 inches)
- Drainage class: Moderately well drained

Slope: 0 to 3 percent
Slope shape: Plane or concave
Flooding: None
Water table: Apparent
Notes: In some places the substratum does not have redoximorphic features, and other places may have many shale fragments. Some places may have surface stones.

Detailed soil descriptions for all map unit components are included in alphabetical order in the section, “Soil Series and Their Morphology.” Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction is available in the “Soil Properties” section.

Management

Major use: Cropland

For information about managing this map unit, see the following sections:
Agronomy
Engineering
Range
Recreation
Soil Properties
Wildlife Habitat

167—Bearden silt loam

Setting

Landform: Lake plain
Landform component: Flats

Map Unit Composition (percent)

Named Components
Bearden and similar soils: 80 to 95
Average Component Composition
Bearden: 70
Bearden, saline: 10
Overly: 9
Glyndon: 4
Colvin: 3
Wyndmere: 3
Lindaas: 1

Named Component Description

Bearden
Surface layer texture: Silt loam
Depth class: Very deep (more than 60 inches)
Drainage class: Somewhat poorly drained
Slope: 0 to 1 percent
Slope shape: Plane
Flooding: None
Water table: Apparent
Notes: In places the accumulated lime is below a depth of 16 inches.

Detailed soil descriptions for all map unit components are included in alphabetical order in the section, “Soil Series and Their Morphology.” Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction is available in the “Soil Properties” section.

Management

Major use: Cropland

For information about managing this map unit, see the following sections:
Agronomy
Engineering
Range
Recreation
Soil Properties
Wildlife Habitat

314—Buse-Barnes loams, 9 to 15 percent slopes

Setting

Landform
Buse: Till plain
Barnes: Till plain
Landform component
Buse: Ridges and knolls
Barnes: Ridges and knolls

Map Unit Composition (percent)

Named Components
Buse and similar soils: 40 to 65
Barnes and similar soils: 30 to 55
Average Component Composition
Buse: 53
Barnes: 25
Svea: 17
Langhei: 2
Coe: 1
Hamerly: 1
Parnell: 1

Named Component Description

Buse
Surface layer texture: Loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Slope: 9 to 15 percent

Position on landform: Summits and shoulder slopes
Slope shape: Convex
Flooding: None
Notes: In some areas, the surface is extremely cobbly. Some areas have steeper slopes.

Named Component Description

Divide
Surface layer texture: Loam
Depth class: Very deep (more than 60 inches)
Drainage class: Somewhat poorly drained
Slope: 0 to 3 percent
Slope shape: Plane
Flooding: None
Water table: Apparent
Notes: In places the surface and subsoil are sandy loam or the depth to sand and gravel may be less than 20 inches. In places the substratum is loam or clay loam or depth to accumulated lime is more than 16 inches.

Detailed soil descriptions for all map unit components are included in alphabetical order in the section, “Soil Series and Their Morphology.” Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction is available in the “Soil Properties” section.

Management

Major use: Cropland or pasture and hayland

For information about managing this map unit, see the following sections:
Agronomy
Engineering
Range
Recreation
Soil Properties
Wildlife Habitat

553—Egeland-Embden fine sandy loams, 0 to 3 percent slopes

Setting

Landform
Egeland: Delta plain
Embden: Delta plain
Landform component
Egeland: Rises
Embden: Swales

Map Unit Composition (percent)

Named Components
Egeland and similar soils: 40 to 65
Embden and similar soils: 20 to 45

Average Component Composition
Egeland: 54
Embden: 32
Wyndmere: 7
Zell: 3
Maddock: 2
Bearden: 1
Hamerly: 1

Named Component Description

Egeland
Surface layer texture: Fine sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Slope: 0 to 3 percent
Slope shape: Convex
Flooding: None
Notes: In some places the surface layer is loam. In places the substratum below a depth of 40 inches is loam, silt loam, or silty clay loam. Slopes may be up to 5 percent.
Embden
Surface layer texture: Fine sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Moderately well drained
Slope: 0 to 3 percent
Slope shape: Plane or concave
Flooding: None
Water table: Apparent
Notes: In places the surface layer is loam. The substratum below a depth of 40 inches is loam, silt loam, or silty clay loam.

Detailed soil descriptions for all map unit components are included in alphabetical order in the section, “Soil Series and Their Morphology.” Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction is available in the “Soil Properties” section.

Management

Major use: Cropland

For information about managing this map unit, see the following sections:
Agronomy
Engineering
Range
Recreation
Soil Properties
Wildlife Habitat

846—Great Bend-Overly silt loams, 0 to 3 percent slopes

Setting

Landform
Great Bend: Lake plain
Overly: Lake plain
Landform component
Great Bend: Rises
Overly: Flats and swales

Map Unit Composition (percent)

Named Components
Great Bend and similar soils: 35 to 60
Overly and similar soils: 30 to 55
Average Component Composition
Great Bend: 35
Overly: 31
Bearden: 16
Eckman: 11
Glyndon: 3
Zell: 2
Colvin, saline: 1
Lindaas: 1

Named Component Description

Great Bend
Surface layer texture: Silt loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Slope: 0 to 3 percent
Slope shape: Convex
Flooding: None
Overly
Surface layer texture: Silt loam
Depth class: Very deep (more than 60 inches)
Drainage class: Moderately well drained
Slope: 0 to 3 percent
Slope shape: Plane or concave
Flooding: None
Water table: Apparent

Detailed soil descriptions for all map unit components are included in alphabetical order in the section, “Soil Series and Their Morphology.” Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction is available in the “Soil Properties” section.

Management

Major use: Cropland

For information about managing this map unit, see the following sections:
Agronomy
Engineering
Range
Recreation
Soil Properties
Wildlife Habitat

871—Hamerly-Cresbard loams, 0 to 3 percent slopes

Setting

Landform
Hamerly: Till plain
Cresbard: Till plain
Landform component
Hamerly: Flats and swales
Cresbard: Rises

Map Unit Composition (percent)

Named Components
Hamerly and similar soils: 35 to 60
Cresbard and similar soils: 25 to 50
Average Component Composition
Hamerly: 41
Cresbard: 37
Hamerly, saline: 8
Barnes: 6
Bearden: 3
Buse: 2
Tonka: 2
Vallers: 1

Named Component Description

Hamerly
Surface layer texture: Loam
Depth class: Very deep (more than 60 inches)
Drainage class: Somewhat poorly drained
Slope: 0 to 3 percent
Slope shape: Plane
Flooding: None
Water table: Apparent
Notes: In places the surface is very stony.
Cresbard
Surface layer texture: Loam
Depth class: Very deep (more than 60 inches)
Drainage class: Moderately well drained
Slope: 0 to 3 percent
Slope shape: Plane or convex
Flooding: None
Water table: Apparent

Sodium affected: Sodic within 30 inches
Notes: In some places the substratum does not have redoximorphic features. In places the surface is very stony.

Detailed soil descriptions for all map unit components are included in alphabetical order in the section, “Soil Series and Their Morphology.” Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction is available in the “Soil Properties” section.

Management

Major use: Cropland

For information about managing this map unit, see the following sections:
Agronomy
Engineering
Range
Recreation
Soil Properties
Wildlife Habitat

883—Hamerly-Tonka-Parnell complex, 0 to 3 percent slope

Setting

Landform
Hamerly: Till plain
Tonka: Till plain
Parnell: Till plain
Landform component
Hamerly: Flats surrounding depressions
Tonka: Depressions
Parnell: Depressions

Map Unit Composition (percent)

Named Components
Hamerly and similar soils: 40 to 65
Tonka and similar soils: 10 to 30
Parnell and similar soils: 10 to 30
Average Component Composition
Hamerly: 44
Tonka: 20
Parnell: 16
Vallers: 6
Barnes: 4
Hamerly, saline: 4
Wyard: 4
Southam: 1
Perella: 1

Named Component Description

Hamerly
Surface layer texture: Loam
Depth class: Very deep (more than 60 inches)
Drainage class: Somewhat poorly drained
Slope: 0 to 3 percent
Slope shape: Plain surrounding depressions
Flooding: None
Water table: Apparent
Notes: In some places the substratum is sand and gravel.
Tonka
Surface layer texture: Silt loam
Depth class: Very deep (more than 60 inches)
Drainage class: Poorly drained
Slope: 0 to 1 percent
Slope shape: Concave
Flooding: None
Water table: Perched
Ponding: Very long
Parnell
Surface layer texture: Silt loam
Depth class: Very deep (more than 60 inches)
Drainage class: Very poorly drained
Slope: 0 to 1 percent
Slope shape: Concave
Flooding: None
Water table: Apparent
Ponding: Very long

Detailed soil descriptions for all map unit components are included in alphabetical order in the section, “Soil Series and Their Morphology.” Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction is available in the “Soil Properties” section.

Management

Major use: Cropland or wildlife habitat

For information about managing this map unit, see the following sections:
Agronomy
Engineering
Range
Recreation
Soil Properties
Wildlife Habitat

926—Hecla loamy fine sand, 0 to 3 percent slopes

Setting

Landform: Delta plain
Landform component: Flats

Map Unit Composition (percent)

Named Components
Hecla and similar soils: 80 to 95
Average Component Composition
Hecla: 67
Towner: 15
Hamar: 8
Swenoda: 4
Ulen: 4
Bearden: 1
Svea: 1

Named Component Description

Hecla
Surface layer texture: Loamy fine sand
Depth class: Very deep (more than 60 inches)
Drainage class: Moderately well drained
Slope: 0 to 3 percent
Slope shape: Plane
Flooding: None
Water table: Apparent
Notes: In places the surface soil is fine sandy loam.

Detailed soil descriptions for all map unit components are included in alphabetical order in the section, “Soil Series and Their Morphology.” Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction is available in the “Soil Properties” section.

Management

Major use: Cropland or pasture and hayland

For information about managing this map unit, see the following sections:
Agronomy
Engineering
Range
Recreation
Soil Properties
Wildlife Habitat

966—Hegne silty clay, saline

Setting

Landform: Lake plain
Landform component: Flats

Map Unit Composition (percent)

Named Components
Hegne and similar soils: 80 to 95
Average Component Composition
Hegne: 83
Hegne, nonsaline: 6
Fargo: 4
Colvin: 2
Marysland: 2
Lallie: 2
Grano: 1

Named Component Description

Hegne
Surface layer texture: Silty clay
Depth class: Very deep (more than 60 inches)
Drainage class: Poorly drained
Slope: 0 to 1 percent
Slope shape: Plane
Flooding: None
Water table: Apparent
Salt affected: Saline within 30 inches
Notes: In places the soil is strongly saline.

Detailed soil descriptions for all map unit components are included in alphabetical order in the section, “Soil Series and Their Morphology.” Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction is available in the “Soil Properties” section.

Management

Major use: Cropland

For information about managing this map unit, see the following sections:
Agronomy
Engineering
Range
Recreation
Soil Properties
Wildlife Habitat

971—Hegne-Fargo silty clays

Setting

Landform
Hegne: Lake plain
Fargo: Lake plain
Landform component
Hegne: Flats
Fargo: Flats

Map Unit Composition (percent)

Named Components
Hegne and similar soils: 50 to 75
Fargo and similar soils: 15 to 35
Average Component Composition
Hegne: 59
Fargo: 22
Hegne, saline: 7
Bearden: 3
Grano: 3
Dovray: 3
Perella: 2
Colvin: 1

Named Component Description

Hegne
Surface layer texture: Silty clay
Depth class: Very deep (more than 60 inches)
Drainage class: Poorly drained
Slope: 0 to 1 percent
Slope shape: Plane
Flooding: None
Water table: Apparent
Notes: In places the surface has a thin veneer of gravel and cobbles.
Fargo
Surface layer texture: Silty clay
Depth class: Very deep (more than 60 inches)
Drainage class: Poorly drained
Slope: 0 to 1 percent
Slope shape: Plane or concave
Flooding: None
Water table: Apparent
Notes: In places the substratum is clay loam or loam

Detailed soil descriptions for all map unit components are included in alphabetical order in the section, “Soil Series and Their Morphology.” Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction is available in the “Soil Properties” section.

Management

Major use: Cropland

For information about managing this map unit, see the following sections:
Agronomy
Engineering
Range
Recreation
Soil Properties
Wildlife Habitat

1221—Maddock-Hecla loamy fine sands, 1 to 6 percent slopes

Setting

Landform
Maddock: Delta plain
Hecla: Delta plain
Landform component
Maddock: Flats and rises
Hecla: Flats and swales

Map Unit Composition (percent)

Named Components
Maddock and similar soils: 50 to 75
Hecla and similar soils: 15 to 35
Average Component Composition
Maddock: 59
Hecla: 23
Towner: 6
Embden: 4
Brantford: 3
Buse: 2
Svea: 2
Ulen: 1

Named Component Description

Maddock
Surface layer texture: Loamy fine sand
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Slope: 1 to 6 percent
Position on landform: Summits and shoulder slopes
Slope shape: Plane or convex
Flooding: None
Notes: In places the surface is fine sandy loam or sandy loam or is less than 10 inches thick and eroded. In places the soil is coarse sand throughout.

Hecla
Surface layer texture: Loamy fine sand
Depth class: Very deep (more than 60 inches)
Drainage class: Moderately well drained
Slope: 1 to 3 percent
Slope shape: Plane or concave
Flooding: None
Water table: Apparent
Notes: In places the surface soil is fine sandy loam or sandy loam.

Detailed soil descriptions for all map unit components are included in alphabetical order in the section, “Soil Series and Their Morphology.” Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction is available in the “Soil Properties” section.

Management

Major use: Cropland

For information about managing this map unit, see the following sections:
Agronomy
Engineering
Range
Recreation
Soil Properties
Wildlife Habitat

1267—Marysland loam

Setting

Landform: Outwash plain
Landform component: Flat

Map Unit Composition (percent)

Named Components
Marysland and similar soils: 75 to 95
Average Component Composition
Marysland: 77
Divide: 11
Colvin: 5
Marysland, saline: 3
Southam: 2
Bearden: 1
Arveson: 1

Named Component Description

Marysland
Surface layer texture: Loam
Depth class: Very deep (more than 60 inches)
Drainage class: Poorly drained
Slope: 0 to 1 percent
Slope shape: Plane
Flooding: None
Water table: Apparent
Notes: In places the accumulated lime is at a depth greater than 16 inches.

Detailed soil descriptions for all map unit components are included in alphabetical order in the section, “Soil Series and Their Morphology.” Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction is available in the “Soil Properties” section.

Management

Major use: Pasture and hayland

For information about managing this map unit, see the following sections:
Agronomy
Engineering
Range
Recreation
Soil Properties
Wildlife Habitat

1426—Parnell silt loam

Setting

Landform: Till plain
Landform component: Depressions

Map Unit Composition (percent)

Named Components
Parnell and similar soils: 75 to 95
Average Component Composition
Parnell: 69
Tonka: 16
Vallers: 8
Wyard: 5
Hamerly: 1
Southam: 1

Named Component Description

Parnell
Surface layer texture: Silt loam
Depth class: Very deep (more than 60 inches)
Drainage class: Very poorly drained
Slope: 0 to 1 percent
Slope shape: Concave
Flooding: None
Water table: Apparent
Ponding: Very long

Detailed soil descriptions for all map unit components are included in alphabetical order in the section, “Soil Series and Their Morphology.” Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction is available in the “Soil Properties” section.

Management

Major use: Cropland or wildlife habitat

For information about managing this map unit, see the following sections:

Agronomy
Engineering
Range
Recreation
Soil Properties
Wildlife Habitat

1466—Pits, gravel and sand

Setting

Landform: Areas from which soil and gravel have been removed. Some areas have been smoothed and overburden material replaced.

Map Unit Composition (percent)

Named Components

Pits, gravel and sand: 82

Average Component Composition

Pits, gravel and sand: 82
Brantford: 5
Coe: 5
Binford: 5
Renshaw: 1
Arvilla: 1
Sioux: 1

Named Component Description

Pits, gravel and sand

Surface layer texture: Extremely gravelly sand
Depth class: Very deep (more than 60 inches)
Drainage class: Excessively drained
Slope: 0 to 60 percent
Flooding: None
Notes: In some places the gravel is more than 30 percent shale.

Detailed soil descriptions for all map unit components are included in alphabetical order in the section, “Soil Series and Their Morphology.” Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction is available in the “Soil Properties” section.

Management

Major use: Mining and wildlife habitat

For information about managing this map unit, see the following sections:

Agronomy
Engineering
Range
Recreation
Soil Properties
Wildlife Habitat

1710—Southam silty clay loam

Setting

Landform: Till plain
Landform component: Depressions

Map Unit Composition (percent)

Named Components

Southam and similar soils: 85 to 99

Average Component Composition

Southam: 92
Parnell: 4
Vallers: 1
Colvin: 1
Colvin, saline: 1
Vallers, saline: 1

Named Component Description

Southam

Surface layer texture: Silty clay loam
Depth class: Very deep (more than 60 inches)
Drainage class: Very poorly drained
Slope: 0 to 1 percent
Slope shape: Concave
Flooding: None
Water table: Apparent
Ponding: Very long
Salt affected: Saline within 30 inches
Notes: In some places sand and gravel are below a depth of 18 inches. These areas are usually ponded with more than 5 feet of water.

Detailed soil descriptions for all map unit components are included in alphabetical order in the section, “Soil Series and Their Morphology.” Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction is available in the “Soil Properties” section.

Management

Major use: Wildlife habitat

For information about managing this map unit, see the following sections:

- Agronomy
- Engineering
- Range
- Recreation
- Soil Properties
- Wildlife Habitat

1782—Swenoda fine sandy loam, 0 to 6 percent slopes

Setting

Landform: Delta plain and till plain
Landform component:

permeability, and soil reaction is available in the “Soil Properties” section.

Management

Major use: Pasture, hayland, or wildlife habitat

For information about managing this map unit, see the following sections:
- Agronomy
- Engineering
- Range
- Recreation
- Soil Properties
- Wildlife Habitat

1886—Hamerly and Vallers loams, saline, 0 to 3 percent slopes

Setting

Landform
- Hamerly: Till plain
- Vallers: Till plain

Landform component
- Hamerly: Flats surrounding depressions
- Vallers: Flats and drainageways

Map Unit Composition (percent)

Named Components
- Hamerly and similar soils: 20 to 80
- Vallers and similar soils: 20 to 80

Average Component Composition
- Hamerly: 44
- Vallers: 24
- Hamerly, nonsaline: 14
- Vallers, nonsaline: 14
- Barnes: 1
- Parnell: 1
- Tonka: 1
- Wyndmere: 1

Named Component Description

Hamerly
- Surface layer texture: Loam
- Depth class: Very deep (more than 60 inches)
- Drainage class: Somewhat poorly drained
- Slope: 0 to 3 percent
- Slope shape: Plane
- Flooding: None
- Water table: Apparent
- Salt affected: Saline within 30 inches
- Notes: In places the subsoil is sand and gravel. Some areas are strongly saline.

Vallers
- Surface layer texture: Loam
- Depth class: Very deep (more than 60 inches)
- Drainage class: Poorly drained
- Slope: 0 to 1 percent
- Slope shape: Plane or concave
- Flooding: None
- Water table: Apparent
- Salt affected: Saline within 30 inches
- Notes: In places the soil is strongly saline.

Detailed soil descriptions for all map unit components are included in alphabetical order in the section, “Soil Series and Their Morphology.” Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction is available in the “Soil Properties” section.

Management

Major use: Cropland or pasture and hayland

For information about managing this map unit, see the following sections:
- Agronomy
- Engineering
- Range
- Recreation
- Soil Properties
- Wildlife Habitat

1978—Water

Setting

Landform Areas, including ponds, lakes, streams and reservoirs, that are covered with water in most years during the period that is warm enough for plants to grow.

Map Unit Composition (percent)

Named Components
- Water: 94

Average Component Composition
- Water: 94
- Southam: 5
- Colvin: 1

Named Component Description

Detailed soil descriptions for all map unit components are included in alphabetical order in the section, “Soil Series and Their Morphology.” Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction is available in the “Soil Properties” section.

Management

Major use: Wildlife habitat

For information about managing this map unit, see the following sections:

Agronomy
Engineering
Range
Recreation
Soil Properties
Wildlife Habitat

2048—Wyndmere fine sandy loam, 0 to 3 percent slopes

Setting

Landform: Delta plain and outwash plain
Landform component: Flats

Map Unit Composition (percent)

Named Components
Wyndmere and similar soils: 70 to 90
Average Component Composition
Wyndmere: 49
Ulen : 25
Hamerly: 7
Hamar : 7
Embden: 6
Hecla: 4
Colvin, saline: 2

Named Component Description

Wyndmere
Surface layer texture: Fine sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Somewhat poorly drained
Slope: 0 to 3 percent
Slope shape: Plane
Flooding: None
Water table: Apparent
Notes: In places the soil is moderately saline. In some places the substratum is sand or gravel.

Detailed soil descriptions for all map unit components are included in alphabetical order in the section, “Soil Series and Their Morphology.” Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction is available in the “Soil Properties” section.

Management

Major use: Cropland

For information about managing this map unit, see the following sections:

Agronomy
Engineering
Range
Recreation
Soil Properties
Wildlife Habitat

2151-Binford-Coe sandy loams, 0 to 6 percent slopes

Setting

Landform
Binford: Outwash plain
Coe: Outwash plain
Landform component
Binford: Flats and rises
Coe: Flats and rises

Map Unit Composition (percent)

Named Components
Binford and similar soils: 35 to 60
Coe and similar soils: 30 to 55
Average Component Composition
Binford: 45
Coe: 45
Brantford: 4
Wyrene: 3
Embden: 1
Wyndmere: 1
Marysland: 1

Named Component Description

Binford
Surface layer texture: Sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Somewhat excessively drained
Slope: 0 to 6 percent
Position on landform: Side slopes and foot slopes
Slope shape: Plane
Flooding: None
Notes: In places the substratum has less shale. Below a depth of 40 inches the texture may be loamy or have more than 35 percent gravel. In places the surface is gravelly sandy loam or the subsoil extends to a depth of 25 to 35 inches.

Coe
Surface layer texture: Sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Excessively drained
Slope: 0 to 6 percent
Position on landform: Summits and shoulder slopes
Slope shape: Convex
Flooding: None
Notes: In some places the surface layer is gravelly sandy loam. In places the substratum has less shale; has less than 35 percent gravel; or the texture below 40 inches is loam.

Detailed soil descriptions for all map unit components are included in alphabetical order in the section, “Soil Series and Their Morphology.” Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction is available in the “Soil Properties” section.

Management

Major use: Cropland

For information about managing this map unit, see the following sections:
Agronomy
Engineering
Range
Recreation
Soil Properties
Wildlife Habitat

2196—Bearden and Colvin silt loams, saline

Setting

Landform
Bearden: Lake plain
Colvin: Lake plain
Landform component
Bearden: Higher lying flats
Colvin: Lower lying flats

Map Unit Composition (percent)

Named Components
Bearden and similar soils: 20 to 95
Colvin and similar soils: 20 to 90

Average Component Composition
Bearden: 25
Colvin: 26
Colvin, nonsaline: 20
Bearden, nonsaline: 17
Aberdeen: 3
Exline: 3
Overly: 3
Parnell: 3

Named Component Description

Bearden
Surface layer texture: Silt loam
Depth class: Very deep (more than 60 inches)
Drainage class: Somewhat poorly drained
Slope: 0 to 1 percent
Slope shape: Plane
Flooding: None
Water table: Apparent
Salt affected: Saline within 30 inches
Colvin
Surface layer texture: Silt loam
Depth class: Very deep (more than 60 inches)
Drainage class: Poorly drained
Slope: 0 to 1 percent
Slope shape: Plane
Flooding: None
Water table: Apparent
Salt affected: Saline within 30 inches
Notes: In places the soil is strongly saline. In places the substratum is sand and gravel.

Detailed soil descriptions for all map unit components are included in alphabetical order in the section, “Soil Series and Their Morphology.” Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction is available in the “Soil Properties” section.

Management

Major use: Cropland or pasture and hayland

For information about managing this map unit, see the following sections:
Agronomy
Engineering
Range
Recreation
Soil Properties
Wildlife Habitat

2208—Brantford-Coe loams, 1 to 6 percent slopes

Setting

Landform
Brantford: Outwash plain
Coe: Outwash plain
Landform component
Brantford: Flats and rises
Coe: Flats and rises

Map Unit Composition (percent)

Named Components
Brantford and similar soils: 45 to 70
Coe and similar soils: 25 to 50
Average Component Composition
Brantford: 52
Coe: 32
Binford: 6
Divide: 4
Vang: 3
Barnes: 1
Marysland: 1
Vallers: 1

Named Component Description

Brantford
Surface layer texture: Loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Slope: 1 to 6 percent
Position on landform: Side slopes and foot slopes
Slope shape: Plane
Flooding: None
Notes: In some places the surface layer is sandy loam or gravelly sandy loam. In places the substratum has less than 20 percent shale; has less than 35 percent gravel; or below a depth of 40 inches the texture is loam.
Coe
Surface layer texture: Loam
Depth class: Very deep (more than 60 inches)
Drainage class: Excessively drained
Slope: 1 to 6 percent
Position on landform: Summits and shoulder slopes
Slope shape: Convex
Flooding: None
Notes: In some places the surface layer is sandy loam or gravelly sandy loam. In places the substratum has less than 20 percent shale; has less than 35 percent gravel; or below a depth of 40 inches the texture is loam.

Detailed soil descriptions for all map unit components are included in alphabetical order in the section, “Soil Series and Their Morphology.” Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction is available in the “Soil Properties” section.

Management

Major use: Cropland

For information about managing this map unit, see the following sections:
Agronomy
Engineering
Range
Recreation
Soil Properties
Wildlife Habitat

2286—Aberdeen-Bearden complex

Setting

Landform
Aberdeen: Lake plain
Bearden: Lake plain
Landform component
Aberdeen: Flats
Bearden: Flats

Map Unit Composition (percent)

Named Components
Aberdeen and similar soils: 45 to 70
Bearden and similar soils: 25 to 45
Average Component Composition
Aberdeen: 47
Bearden: 30
Overly: 7
Great Bend: 5
Lindaas: 4
Bearden, saline: 3
Fargo: 2
Exline: 2

Named Component Description

Aberdeen
Surface layer texture: Silty clay loam
Depth class: Very deep (more than 60 inches)
Drainage class: Moderately well drained
Slope: 0 to 1 percent
Slope shape: Plane
Flooding: None
Water table: Apparent
Sodium affected: Sodic within 30 inches

Bearden
Surface layer texture: Silt loam
Depth class: Very deep (more than 60 inches)
Drainage class: Somewhat poorly drained
Slope: 0 to 1 percent
Slope shape: Plane
Flooding: None
Water table: Apparent

Detailed soil descriptions for all map unit components are included in alphabetical order in the section, “Soil Series and Their Morphology.” Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction is available in the “Soil Properties” section.

Management

Major use: Cropland

For information about managing this map unit, see the following sections:
Agronomy
Engineering
Range
Recreation
Soil Properties
Wildlife Habitat

2287—Bearden-Lindaas silt loams

Setting

Landform
Bearden: Lake plain
Lindaas: Lake plain
Landform component
Bearden: Flats surrounding depressions
Lindaas: Depressions

Map Unit Composition (percent)

Named Components
Bearden and similar soils: 40 to 65
Lindaas and similar soils: 20 to 45
Average Component Composition
Bearden: 47
Lindaas: 23
Perella: 10
Bearden, saline: 6
Overly: 5
Hegne: 4
Great Bend: 3
Aberdeen: 2

Named Component Description

Bearden
Surface layer texture: Silt loam
Depth class: Very deep (more than 60 inches)
Drainage class: Somewhat poorly drained
Slope: 0 to 1 percent
Slope shape: Plane
Flooding: None
Water table: Apparent
Lindaas
Surface layer texture: Silt loam
Depth class: Very deep (more than 60 inches)
Drainage class: Poorly drained
Slope: 0 to 1 percent
Slope shape: Concave
Flooding: None
Water table: Perched
Ponding: Very long

Detailed soil descriptions for all map unit components are included in alphabetical order in the section, “Soil Series and Their Morphology.” Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction is available in the “Soil Properties” section.

Management

Major use: Cropland

For information about managing this map unit, see the following sections:
Agronomy
Engineering
Range
Recreation
Soil Properties
Wildlife Habitat

2288—Brantford-Divide loams, 1 to 3 percent slopes

Setting

Landform
Brantford: Outwash plain
Divide: Outwash plain
Landform component
Brantford: Higher lying flats
Divide: Lower lying flats

Map Unit Composition (percent)

Named Components
- Brantford and similar soils: 35 to 60
- Divide and similar soils: 25 to 45

Average Component Composition
- Brantford: 38
- Divide: 33
- Vang: 13
- Hamerly: 6
- Coe: 5
- Wyrene: 3
- Barnes: 1
- Parnell: 1

Named Component Description

Brantford
- Surface layer texture: Loam
- Depth class: Very deep (more than 60 inches)
- Drainage class: Well drained
- Slope: 1 to 3 percent
- Slope shape: Plane
- Flooding: None
- Notes: In some places the surface layer is sandy loam. In places the substratum has less than 20 percent shale.

Divide
- Surface layer texture: Loam
- Depth class: Very deep (more than 60 inches)
- Drainage class: Somewhat poorly drained
- Slope: 1 to 3 percent
- Slope shape: Plane
- Flooding: None
- Water table: Apparent
- Notes: In places the calcareous subsoil is below a depth of 16 inches.

Detailed soil descriptions for all map unit components are included in alphabetical order in the section, “Soil Series and Their Morphology.” Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction is available in the “Soil Properties” section.

Management

Major use: Cropland

For information about managing this map unit, see the following sections:
- Agronomy
- Engineering
- Range
- Recreation
- Soil Properties
- Wildlife Habitat

2289—Buse-Svea-Lamoure complex, 0 to 35 percent slopes

Setting

Landform
- Buse: Till plain
- Svea: Till plain
- Lamoure: Till plain

Landform component
- Buse: Ridges
- Svea: Ridges
- Lamoure: Flood plains

Map Unit Composition (percent)

Named Components
- Buse and similar soils: 25 to 50
- Svea and similar soils: 20 to 40
- Lamoure and similar soils: 15 to 40

Average Component Composition
- Buse: 32
- Svea: 21
- Lamoure: 15
- La Prairie: 13
- Barnes: 11
- Langhei: 3
- Southam: 2
- Arveson: 2
- Marysland: 1

Named Component Description

Buse
- Surface layer texture: Loam
- Depth class: Very deep (more than 60 inches)
- Drainage class: Well drained
- Slope: 9 to 35 percent
- Position on landform: Summits and shoulder slopes
- Slope shape: Convex
- Flooding: None

Svea
- Surface layer texture: Loam
- Depth class: Very deep (more than 60 inches)
- Drainage class: Well drained
- Slope: 6 to 25 percent
- Position on landform: Side slopes and foot slopes
- Slope shape: Plane or concave
- Flooding: None
- Notes: In some places the substratum has redoximorphic features.

Lamoure
- Surface layer texture: Silty clay loam
- Depth class: Very deep (more than 60 inches)
- Drainage class: Poorly drained

Slope: 0 to 1 percent
Slope shape: Plane or concave
Flooding: Frequent
Water table: Apparent
Notes: In places the soil is saline or strongly saline. In some places the accumulated lime is above a depth of 16 inches.

Detailed soil descriptions for all map unit components are included in alphabetical order in the section, “Soil Series and Their Morphology.” Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction is available in the “Soil Properties” section.

Management

Major use: Cropland or wildlife habitat

For information about managing this map unit, see the following sections:
Agronomy
Engineering
Range
Recreation
Soil Properties
Wildlife Habitat

2290—Coe-Binford sandy loams, 6 to 15 percent slopes

Setting

Landform
Coe: Outwash plain
Binford: Outwash plain
Landform component
Coe: Ridges and knolls
Binford: Ridges and knolls

Map Unit Composition (percent)

Named Components
Coe and similar soils: 30 to 55
Binford and similar soils: 25 to 45
Average Component Composition
Coe: 46
Binford: 27
Maddock: 8
Barnes: 7
La Prairie: 6
Buse: 3
Hamerly: 2
Wyndmere: 1

Named Component Description

Coe
Surface layer texture: Sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Excessively drained
Slope: 6 to 15 percent
Position on landform: Summits and shoulder slopes
Slope shape: Convex
Flooding: None
Notes: In some places the surface is loam or gravelly sandy loam. In places the substratum has less than 20 percent shale; has less than 35 percent gravel; or below a depth of 40 inches the texture is loam.
Binford
Surface layer texture: Sandy loam
Depth class: Very deep (more than 60 inches)
Drainage class: Somewhat excessively drained
Slope: 6 to 15 percent
Position on landform: Side slopes and foot slopes
Slope shape: Plane
Flooding: None
Notes: In some place the surface is loam or gravelly sandy loam. In places the substratum is less than 20 percent shale; has less than 35 percent gravel; the depth to gravel is more than 25 inches; or below a depth of 40 inches the texture is loam.

Detailed soil descriptions for all map unit components are included in alphabetical order in the section, “Soil Series and Their Morphology.” Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction is available in the “Soil Properties” section.

Management

Major use: Cropland or pasture and hayland

For information about managing this map unit, see the following sections:
Agronomy
Engineering
Range
Recreation
Soil Properties
Wildlife Habitat

2291—Great Bend-Zell silt loams, 3 to 6 percent slopes

Setting

Landform
Great Bend: Lake plain
Zell: Lake plain
Landform component
Great Bend: Knolls
Zell: Knolls

Map Unit Composition (percent)

Named Components
Great Bend and similar soils: 35 to 60
Zell and similar soils: 25 to 45
Average Component Composition
Great Bend: 33
Zell: 35
Overly: 17
Egeland: 6
Embden: 5
Bearden: 2
Coe: 1
Tonka: 1

Named Component Description

Great Bend
Surface layer texture: Silt loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Slope: 3 to 6 percent
Position on landform: Side slopes
Slope shape: Plane and convex
Flooding: None

Zell
Surface layer texture: Silt loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Slope: 3 to 6 percent
Position on landform: Summits and shoulder slopes
Slope shape: Convex
Flooding: None

Detailed soil descriptions for all map unit components are included in alphabetical order in the section, “Soil Series and Their Morphology.” Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction is available in the “Soil Properties” section.

Management

Major use: Cropland

For information about managing this map unit, see the following sections:
Agronomy
Engineering
Range
Recreation
Soil Properties
Wildlife Habitat

2292—Hamerly-Barnes loams, 0 to 3 percent slopes

Setting

Landform
Hamerly: Till plain
Barnes: Till plain
Landform component
Hamerly: Flats
Barnes: Rises

Map Unit Composition (percent)

Named Components
Hamerly and similar soils: 45 to 70
Barnes and similar soils: 20 to 45
Average Component Composition
Hamerly: 50
Barnes: 25
Vallers: 8
Tonka: 7
Svea: 7
Parnell: 1
Buse: 1
Cresbard: 1

Named Component Description

Hamerly
Surface layer texture: Loam
Depth class: Very deep (more than 60 inches)
Drainage class: Somewhat poorly drained
Slope: 0 to 3 percent
Slope shape: Plane
Flooding: None
Water table: Apparent
Notes: In some places the substratum may be sand or gravel. In places the surface may be very stony.

Barnes
Surface layer texture: Loam
Depth class: Very deep (more than 60 inches)
Drainage class: Well drained
Slope: 0 to 3 percent
Slope shape: Convex
Flooding: None
Notes: In some places the substratum may be sand or gravel. In places the surface may be very stony.

Detailed soil descriptions for all map unit components are included in alphabetical order in the section, “Soil Series and Their Morphology.” Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction is available in the “Soil Properties” section.

Management

Major use: Cropland

For information about managing this map unit, see the following sections:
Agronomy
Engineering
Range
Recreation
Soil Properties
Wildlife Habitat

2293—Lamoure-Colvin complex, channeled

Setting

Landform
Lamoure: Till plain
Colvin: Till plain
Landform component
Lamoure: Flood plains
Colvin: Flood plains

Map Unit Composition (percent)

Named Components
Lamoure and similar soils: 35 to 60
Colvin and similar soils: 20 to 40
Average Component Composition
Lamoure: 51
Colvin: 31
La Prairie: 6
Hamerly: 5
Wyard: 4
Brantford: 1
Parnell: 1
Tonka: 1

Named Component Description

Lamoure
Surface layer texture: Silty clay loam
Depth class: Very deep (more than 60 inches)
Drainage class: Poorly drained
Slope: 0 to 1 percent
Slope shape: Plane or concave
Flooding: Frequent
Water table: Apparent
Notes: In places the soil is saline. In places the soil has a sand and gravel substratum.
Colvin
Surface layer texture: Silt loam
Depth class: Very deep (more than 60 inches)
Drainage class: Poorly drained
Slope: 0 to 1 percent
Slope shape: Plane
Flooding: Frequent
Water table: Apparent
Notes: In some places the soil is saline. In places the soil has a sand and gravel substratum.

Detailed soil descriptions for all map unit components are included in alphabetical order in the section, “Soil Series and Their Morphology.” Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction is available in the “Soil Properties” section.

Management

Major use: Rangeland or wildlife habitat

For information about managing this map unit, see the following sections:
Agronomy
Engineering
Range
Recreation
Soil Properties
Wildlife Habitat

2324—Wyndmere-Tiffany loams, silty substratum

Setting

Landform
Wyndmere: Lake plain
Tiffany: Lake plain

Landform component
Wyndmere: Flats
Tiffany: Flats

Map Unit Composition (percent)

Named Components
Wyndmere and similar soils: 30 to 55
Tiffany and similar soils: 25 to 50
Average Component Composition
Wyndmere: 47
Tiffany: 39
Bearden: 6
Gardena: 3
Swenoda: 3
Perella: 1
Lindaas: 1

Named Component Description

Wyndmere
Surface layer texture: Loam
Depth class: Very deep (more than 60 inches)
Drainage class: Somewhat poorly drained
Slope: 0 to 1 percent
Slope shape: Plane
Flooding: None
Water table: Apparent

Tiffany
Surface layer texture: Loam
Depth class: Very deep (more than 60 inches)
Drainage class: Somewhat poorly drained
Slope: 0 to 1 percent
Slope shape: Plane
Flooding: None
Water table: Apparent

Detailed soil descriptions for all map unit components are included in alphabetical order in the section, “Soil Series and Their Morphology.” Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction is available in the “Soil Properties” section.

Management

Major use: Cropland

For information about managing this map unit, see the following sections:
Agronomy
Engineering
Range
Recreation
Soil Properties
Wildlife Habitat

Table 4.—Acreage and Proportionate Extent of the Soils

Map symbol	Soil name	Acres	Percent
118	Barnes-Buse loams, 3 to 6 percent slopes	134,700	20.2
120	Barnes-Buse loams, 6 to 9 percent slopes	22,330	3.3
154	Barnes-Svea loams, 0 to 3 percent slopes	47,610	7.1
167	Bearden silt loam	15,670	2.4
314	Buse-Barnes loams, 9 to 15 percent slopes	3,075	0.5
450	Colvin silt loam	6,865	1.0
511	Divide loam, 0 to 3 percent slopes	14,495	2.2
553	Egeland-Embden fine sandy loams, 0 to 3 percent slopes	2,460	0.4
846	Great Bend-Overly silt loams, 0 to 3 percent slopes	10,485	1.6
871	Hamerly-Cresbard loams, 0 to 3 percent slopes	2,760	0.4
883	Hamerly-Tonka-Parnell complex, 0 to 3 percent slopes	125,940	18.9
926	Hecla loamy fine sand, 0 to 3 percent slopes	1,980	0.3
966	Hegne silty clay, saline	1,340	0.2
971	Hegne-Fargo silty clays	3,725	0.6
1221	Maddock-Hecla loamy fine sands, 1 to 6 percent slopes	3,140	0.5
1267	Marysland loam	1,530	0.2
1426	Parnell silt loam	11,080	1.7
1466	Pits, gravel and sand	425	*
1710	Southam silty clay loam	9,970	1.5
1782	Swenoda fine sandy loam, 0 to 6 percent slopes	7,410	1.1
1884	Vallers, saline-Parnell complex	25,400	3.8
1886	Hamerly and Vallers loams, saline, 0 to 3 percent slopes	22,615	3.4
1978	Water	4,005	0.6
2048	Wyndmere fine sandy loam, 0 to 3 percent slopes	6,550	1.0
2151	Binford-Coe sandy loams, 0 to 6 percent slopes	975	0.1
2196	Bearden and Colvin silt loams, saline	8,370	1.3
2208	Brantford-Coe loams, 1 to 6 percent slopes	8,430	1.3
2286	Aberdeen-Bearden complex	2,290	0.3
2287	Bearden-Lindaas silt loams	9,370	1.4
2288	Brantford-Divide loams, 1 to 3 percent slopes	4,510	0.7
2289	Buse-Svea-Lamoure complex, 0 to 35 percent slopes	3,155	0.5
2290	Coe-Binford sandy loams, 6 to 15 percent slopes	2,805	0.4
2291	Great Bend-Zell silt loams, 3 to 6 percent slopes	1,730	0.3
2292	Hamerly-Barnes loams, 0 to 3 percent slopes	126,695	19.0
2293	Lamoure-Colvin complex, channeled	9,260	1.4
2324	Wyndmere-Tiffany loams, silty substratum	3,450	0.5
	Total	666,600	100.0

* less than 0.1 percent

Formation and Classification of the Soils

This section relates the soils in the survey area to the major factors of soil formation and describes the system of soil classification.

Formation of the Soils

Soil forms through processes acting on deposited or accumulated geologic material. Characteristics of the soil at any given point are determined by (1) the physical and mineralogical composition of the parent material; (2) the climate under which the soil material has accumulated and existed since accumulation; (3) the plant and animal life on and in the soil; (4) the relief, or lay of the land; and (5) the length of time that forces of soil formation have acted on the soil material.

Climate and plant and animal life, are active factors of soil formation. They act on the parent material that has accumulated through the weathering of geological deposits and slowly change it to a natural body that has genetically related horizons. The effects of climate and plant and animal life are conditioned by relief. Finally, time is needed for changing the parent material into soil. Some time is always required for the differentiation of soil horizons. Usually, a long time is required for the development of distinct horizons.

The factors of soil formation are so closely interrelated in their effects on the soil that few generalizations can be made regarding the effects of any one factor unless conditions are specified for the other four. Many of the processes of soil development are unknown.

Parent Material

Parent material is the unconsolidated mass in which a soil forms. It determines the limits of the chemical and mineralogy composition of the soil. The soils of Towner County formed in glacial drift. The advancing glacier picked up rocks and soil, ground and mixed them, and deposited the material as the glacier receded. Some soils, such as Barnes and Svea, formed in unsorted material, or glacial till. Some soils such as Overly and Bearden formed in glaciolacustrine deposits, or glacial material deposited by water in glacial lakes. Other soils, such as Binford and Coe, formed in glaciofluvial deposits, or material deposited by glacial meltwater. Although the parent materials are of common glacial origin, their properties vary greatly, sometimes within small areas, depending on how the materials were deposited. In Towner County, the glacial material overlies the Cretaceous-aged Pierre Formation. This material consists of mostly marine shales (Bluemle, 1984).

Several processes have been involved in the formation of soils in Towner County. These processes are accumulation of organic matter; solution, transfer, and removal of calcium carbonates and bases; and liberation and translocation of silicate clay minerals. In most soils more than one of these processes have been active in horizon differentiation.

The parent materials in which most of the soils developed initially contained generous amounts of calcium and magnesium carbonate minerals. These minerals have been dissolved by water and removed from the upper horizons of the soil profile. Pure water is not an effective agent for dissolving calcium and magnesium carbonates. These minerals are only slightly soluble in pure water, but become moderately soluble and dissolve much more rapidly in a weak acid. The respiratory activity of plants is a significant factor in dissolving calcium and magnesium carbonates. As plants respire, they give off carbon dioxide. Carbon dioxide dissolves in water to form a weak carbonic acid solution. This facilitates dissolving calcium and magnesium carbonates in the soil.

In a dissolved state, calcium and magnesium are in the form of ions that have a positive net electrical charge. Calcium and magnesium ions are essential elements in plant nutrition, and can either be taken up by plant roots or carried away (leached) with moving soil water. Some of the calcium and magnesium ions are leached from the soil profiles. “Seep” sites along steep slopes that have deposits of recently precipitated calcium and magnesium carbonates provide evidence of leaching.

A large number of the calcium and magnesium ions that dissolved from carbonate mineral ions are translocated to upper soil horizons by a cyclical process of root uptake and ultimate release when plant material decomposes. As vegetation decays, positively charged calcium and magnesium ions move downward with water to the upper horizons of soil profiles. There they are held by the electrostatic forces of negatively charged clay particles and are again available for plant uptake.

Climate

Climate has direct and indirect effects on the formation of soils. Precipitation, temperature, and wind directly affect the weathering and reworking of soil material. The climate indirectly affects soil formation through its effects on the amount and kind of vegetation and animal life on or in the soil.

In addition to weathering soil material, precipitation and temperature affect the leaching and redistribution of carbonates and clay particles and the accumulation of organic matter in the soil. Freezing and thawing help to break down soil particles in the parent material, thereby providing more surface area for chemical processes. Cool temperatures affect the content of organic matter by slowing the decay of plant material and animal remains.

Towner County has a continental, subhumid climate characterized by long, cold winters and short, warm summers. The soil is generally frozen to a depth of 3 to 6 feet from November to April. During this time, except for some effects of frost action, the soil forming processes are mostly dormant. Most of the precipitation falls during the growing season and is distributed in an erratic pattern. It is during this part of the year that soil forming processes influenced by climate are most active. The climate is fairly uniform throughout the county.

Living Organisms

Soils in Towner County formed mainly under grassland vegetation. Grasses provide a plentiful supply of organic matter, which improves the chemical and physical properties of the soil. Fibrous roots of these grasses penetrate the soil to a depth of several feet, making it more porous and more granular. As a result of these changes in the soil, less water runs off the surface and more moisture is available for increased microbiological activity. Decay of plants improves the available water capacity, tilth, and fertility of the soil. Decayed organic matter, accumulating over long periods, gives the surface layer its dark color.

On somewhat poorly drained and moderately well drained, nearly level soils, such as Bearden, Embden, Hamerly, and Svea, the native vegetation is mainly tall and medium-sized grasses. Principal grasses are big bluestem, switchgrass, indiangrass, and little bluestem.

On well drained and excessively drained, nearly level to steep soils, such as Buse and Coe, short and medium-sized grasses are dominant. Among these grasses are green needlegrass, western wheatgrass, little bluestem, sideoats grama, plains muhly, and blue grama.

On the poorly drained and very poorly drained, depressional soils such as Colvin, Parnell, and Tonka, the vegetation consists of tall grasses, reeds, rivergrass, slough sedge, American mannagrass, northern reedgrass, and prairie cordgrass.

Micro-organisms have important effects on soil formation because they feed on undecomposed organic matter and convert it into humus from which plants can obtain nutrients for growth. Bacteria and different kinds of fungi attack leaves and other forms of organic matter. Insects, earthworms, and small burrowing animals help mix the humus with the soil.

Human activities greatly affect soil formation. Management measures can alter soil drainage. They can help to control erosion, thus maintaining fertility. Poor management can increase the susceptibility to erosion and thus result in an unproductive soil.

Topography

Most of Towner County is level to undulating, but some areas are rolling to steep. Many poorly drained and very poorly drained soils in depressions receive runoff from higher elevations. The steepest areas are end moraines and breaks around rivers and drainageways. Local differences in relief within a square mile range from less than 10 feet to 50 to 150 feet.

Relief influences the formation of soil through its effect on drainage, runoff, and erosion. Many differences in the soils of this county result from their topographic position. Among these differences are drainage, thickness of the A horizon, content of organic matter, color, features of the subsoil, thickness of the solum, and degree of horizon differentiation.

Runoff is rapid on steep slopes, and only a small percentage of the rainfall penetrates the soil. Under these conditions, there is little moisture for plant growth and soil development. The soils on steeper slopes are thin and low in organic matter content. They have weak horizonation. Examples of these are Buse soils.

Soils on nearly level to rolling slopes are moderately well drained and well drained. Moisture is sufficient to support good stands of mixed native grasses, and the soils have well developed profiles characterized by a black to very dark gray A horizon and a brown to very dark brown B horizon. Examples of these are Barnes soils. Most of the moderately well drained soils occur on level or slightly concave areas. They generally have a thicker A horizon, a darker colored B horizon, and a greater depth to lime than those on convex, undulating, or rolling landscapes. Examples of these are Svea and Swenoda soils.

Depressional areas that receive large amounts of runoff from higher elevations have somewhat poor to very poor natural drainage. Soils formed in depressions vary widely in profile development, depending on the degree of wetness. Parnell and Tonka soils, which are in shallow depressions, exhibit an advanced degree of horizonation because of alternate wet and dry cycles that occur in these depressions. These soils have properties much like soils from areas of much higher precipitation. They are examples of soils in which translocated clays have accumulated in the Bt horizon. Gleying, or the reduction and transfer of iron, has occurred to some degree in all of the very poorly to somewhat poorly drained soils in the county. In these naturally wet soils, this process has had a significant influence on horizon differentiation. The gray color and redoximorphic features of the subsoil TwtrySoils thex,uouse modey have

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Each order is identified by a word ending in *sol*. An example is Mollisol.

SUBORDER. Each order is divided into suborders primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Aquoll (*Aqu*, meaning water, plus *oll*, from Mollisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Epiaquoll (*Epi*, meaning perched water table, plus *aquolls*, the suborder of the Mollisols that has an aquic moisture regime).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Typic* identifies the subgroup that typifies the great group. An example is Typic Epiaquolls.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Generally, the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle-size class, mineral content, temperature regime, thickness of the root zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is fine-silty, mixed, superactive, frigid, Typic Epiaquolls.

SERIES. The series consists of soils that have similar horizons in their profile. The horizons are similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. The texture of the surface layer or of the substratum can differ within a series. An example is the Perella series.

Table 5.—Classification of the Soils

Soil name	Family or higher taxonomic class
Aberdeen	Fine, smectitic Glossic Udic Natriborolls
Arveson	Coarse-loamy, mixed, superactive, frigid Typic Calciaquolls
Arvilla	Sandy, mixed Udic Haploborolls
Barnes	Fine-loamy, mixed, superactive Udic Haploborolls
Bearden	Fine-silty, mixed, superactive, frigid Aeric Calciaquolls
Binford	Sandy, mixed Udic Haploborolls
Brantford	Fine-loamy over sandy or sandy-skeletal, mixed, superactive Udic Haploborolls
Buse	Fine-loamy, mixed, superactive Udic Calciborolls
Coe	Sandy-skeletal, mixed Udorthentic Haploborolls
Colvin	Fine-silty, mixed, superactive, frigid Typic Calciaquolls
Cresbard	Fine, smectitic Glossic Udic Natriborolls
Divide	Fine-loamy over sandy or sandy-skeletal, mixed, superactive, frigid Aeric Calciaquolls
Dovray	Fine, smectitic, frigid Cumulic Vertic Epiaquolls
Eckman	Coarse-silty, mixed, superactive Udic Haploborolls
Egeland	Coarse-loamy, mixed, superactive Udic Haploborolls
Embden	Coarse-loamy, mixed, superactive Pachic Udic Haploborolls
Exline	Fine, smectitic Leptic Natriborolls
Fargo	Fine, smectitic, frigid Typic Epiaquerts
Gardena	Coarse-silty, mixed, superactive, frigid Pachic Haploborolls
Glyndon	Coarse-silty, mixed, superactive, frigid Aeric Calciaquolls
Grano	Fine, smectitic, frigid Typic Endoaquerts
Great Bend	Fine-silty, mixed, superactive Udic Haploborolls
Hamar	Sandy, mixed, frigid Typic Endoaquolls
Hamerly	Fine-loamy, mixed, superactive, frigid Aeric Calciaquolls
Hecla	Sandy, mixed Aquic Haploborolls
Hegne	Fine, smectitic, frigid Typic Calciaquerts
Kensal	Fine-loamy over sandy or sandy skeletal, mixed, superactive Aquic Haploborolls
La Prairie	Fine-loamy, mixed, superactive Cumulic Udic Haploborolls
Lallie	Fine, smectitic, calcareous, frigid Vertic Fluvaquents
Lamoure	Fine-silty, mixed, superactive, calcareous, frigid Cumulic Endoaquolls
Langhei	Fine-loamy, mixed, superactive, frigid Typic Eutrochrepts
Lanona	Coarse-loamy, mixed, superactive Udic Haploborolls
Lindaas	Fine, smectitic, frigid Typic Argiaquolls
Maddock	Sandy, mixed Udorthentic Haploborolls
Marysland	Fine-loamy over sandy or sandy-skeletal, mixed, superactive, frigid Typic Calciaquolls
Overly	Fine-silty, mixed, superactive Pachic Udic Haploborolls
Parnell	Fine, smectitic, frigid Vertic Argiaquolls
Perella	Fine-silty, mixed, superactive, frigid Typic Epiaquolls
Renshaw	Fine-loamy over sandy or sandy-skeletal, mixed, superactive Udic Haploborolls
Sioux	Sandy-skeletal, mixed Udorthentic Haploborolls
Southam	Fine, smectitic, calcareous, frigid Cumulic Vertic Endoaquolls
Svea	Fine-loamy, mixed, superactive Pachic Udic Haploborolls
Swenoda	Coarse-loamy, mixed, superactive Pachic Udic Haploborolls
Tiffany	Coarse-loamy, mixed, superactive, frigid Typic Endoaquolls
Tonka	Fine, smectitic, frigid Argiaquic Argialbolls
Towner	Sandy over loamy, mixed, superactive Udorthentic Haploborolls
Ulen	Fine-sandy, mixed, frigid Aeric Calciaquolls
Vallers	Fine-loamy, mixed, superactive, frigid Typic Calciaquolls
Vang	Fine-loamy over sandy or sandy-skeletal, mixed, superactive Pachic Udic Haploborolls
Wyard	Fine-loamy, mixed, superactive, frigid Typic Epiaquolls
Wyndmere	Coarse-loamy, mixed, superactive, frigid Aeric Calciaquolls
Wyrene	Sandy, mixed, frigid Aeric Calciaquolls
Zell	Coarse-silty, mixed, superactive Udic Calciborolls

Soil Series and Their Morphology

In this section, each soil series recognized in the survey area is described. The descriptions are arranged in alphabetical order.

Characteristics of the soil and the material in which it formed are identified for each series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the Soil Survey Manual (Soil Survey Staff 1993). Many of the technical terms used in the descriptions are defined in Soil Taxonomy (USDA-SCS 1975) and Keys to Soil Taxonomy (Soil Survey Staff 1996a). Unless otherwise stated, colors in the descriptions are for moist soil and effervescence refers to disseminated lime throughout the horizon. Following the pedon description is the range of important characteristics of the soil series.

Aberdeen Series

Depth class: Very deep
Drainage class: Moderately well drained
Permeability: Slow
Landform: Lake plains
Parent material: Glaciolacustrine deposits
Slope: 0 to 1 percent
Notes: These soils are sodic.

Taxonomic class: Fine, smectitic Glossic Udic Natriborolls

Typical Pedon
Aberdeen silty clay loam in an area of Aberdeen-Bearden complex, 2,300 feet south and 1,910 feet west of the northeast corner of sec. 30, T. 158 N., R. 65 W.

Ap—0 to 8 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; weak medium subangular blocky structure parting to weak fine granular; hard, friable, slightly sticky and slightly plastic; common very fine and few fine roots; neutral; abrupt wavy boundary.

B/E—8 to 11 inches; very dark gray (10YR 3/1) silty clay loam, dark gray (10YR 4/1) dry (B); weak medium prismatic structure parting to moderate medium subangular blocky; neutral; very dark grayish brown (10YR 3/2) silty clay loam, dark grayish brown (10YR 4/2) dry (E); weak fine platy structure; hard, friable, slightly sticky and slightly plastic; few very fine roots; neutral; common distinct clay films on faces of peds; clear wavy boundary.

Btn—11 to 21 inches; black (10YR 2/1) silty clay, very dark gray (10YR 3/1) dry; weak medium prismatic structure parting to strong medium subangular blocky; very hard, firm, moderately sticky and moderately plastic; few very fine roots; common fine sand grains on faces of peds; slightly alkaline; many prominent clay films on faces of peds; clear wavy boundary.

Btkn—21 to 25 inches; dark grayish brown (2.5Y 4/2) silty clay, grayish brown (2.5Y 5/2) dry; moderate medium subangular blocky structure; very hard, firm, moderately sticky and moderately plastic; few very fine roots; 1 to 2 inch wide tongues of black (10YR 2/1) Btn horizon material in upper 3 inches; moderately alkaline; few distinct clay films on faces of peds; common fine soft masses of lime pedogenic; slightly effervescent throughout (HCl, unspecified); gradual wavy boundary.

Bky—25 to 31 inches; light olive brown (2.5Y 5/3) silty clay loam, light yellowish brown (2.5Y 6/3) dry; weak medium subangular blocky structure; hard, friable, moderately sticky and moderately plastic; moderately alkaline; common medium nests of gypsum pedogenic and common fine faint grayish brown (2.5Y 5/2) iron depletions pedogenic and few fine prominent yellowish brown (10YR 5/6) masses of iron accumulation pedogenic; strongly effervescent throughout (HCl, unspecified); gradual wavy boundary.

C1—31 to 47 inches; light olive brown (2.5Y 5/3) silty clay loam, light yellowish brown (2.5Y 6/3) dry; massive; hard, friable, moderately sticky and moderately plastic; moderately alkaline; few fine and medium faint grayish brown (2.5Y 5/2) iron depletions pedogenic and common medium prominent yellowish brown (10YR 5/6) masses of

iron accumulation pedogenic; strongly effervescent throughout (HCl, unspecified); gradual wavy boundary.

C2—47 to 60 inches; olive brown (2.5Y 4/3) stratified silty clay loam and silty clay, light olive brown (2.5Y 5/3) dry; massive; hard, firm, moderately sticky and moderately plastic; moderately alkaline; common fine nests of gypsum pedogenic and common medium faint grayish brown (2.5Y 5/2) iron depletions pedogenic and common medium and coarse prominent yellowish brown (10YR 5/6) masses of iron accumulation pedogenic; strongly effervescent throughout (HCl, unspecified).

Range in Characteristics

Depth to lime: 16 to 32 inches
Notes: Some pedons have E horizons.

Ap horizon:
Value: 2 or 3, 3 or 4 dry

B/E horizon:
Value: 3 or 4, 4 or 5 dry

Bt horizon:
Chroma: 1 to 3
Texture: silty clay, silty clay loam or clay

Bky horizon:
Hue: 2.5Y or 5Y
Value: 3 to 5, 5 to 7 dry
Chroma: 1 to 4

Arveson Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Moderate or moderately rapid
Landform: Lake plains
Parent material: Glaciolacustrine deposits
Slope: 0 to 1 percent
Notes: These soils are highly calcareous.

Taxonomic class: Coarse-loamy, mixed, superactive, frigid Typic Calciaquolls

Typical pedon: (Outside Towner County) Arveson clay loam, 660 feet west and 165 feet north of the southeast corner of sec. 25, T. 142 N., R. 46 W.

A—0 to 8 inches (10YR 2/1), broken face, clay loam, dark gray (10YR 4/1), broken face, dry; weak fine granular structure; very friable, slightly sticky; strongly effervescent throughout (HCl, unspecified); slightly alkaline; gradual smooth boundary.

Bk—8 to 14 inches; very dark gray (10YR 3/1), broken face, clay loam, gray (10YR 5/1), broken face, dry; weak very fine granular structure; very friable, slightly sticky; violently effervescent throughout (HCl, unspecified); moderately alkaline; gradual wavy boundary.

Bkg1—14 to 25 inches; light gray (5Y 7/1), broken face, loam; weak very fine granular structure; very friable, slightly sticky; violently effervescent throughout (HCl, unspecified); common tongues of very dark gray (10YR 3/1) Bk material; moderately alkaline; clear wavy boundary.

Bkg2—25 to 34 inches; gray (5Y 6/1), broken face, sandy loam; weak very fine granular structure; very friable, slightly sticky; many fine gray (5Y 5/1) and many medium gray (5Y 5/1) masses of lime: violently effervescent throughout (HCl, unspecified); moderately alkaline; clear smooth boundary.

2Cg1—34 to 46 inches; gray (5Y 6/1) loamy sand; weak very fine granular structure; very friable, slightly sticky; few fine distinct pale olive (5Y 6/3) masses of iron accumulation pedogenic; strongly effervescent throughout (HCl, unspecified); moderately alkaline; clear smooth boundary.

2Cg2—46 to 60 inches; light olive gray (5Y 6/2) fine sand; single grain; loose; few fine prominent olive yellow (2.5Y 6/8) and few fine distinct light reddish brown (5Y 6/4) masses of iron accumulation pedogenic; slightly effervescent throughout (HCl, unspecified); moderately alkaline.

Range in Characteristics

Mollic epipedon thickness: 7 to 24 inches
Depth to loamy fine sand or coarser material: Greater than 20 inches

A horizon:
Texture: sandy loam, fine sandy loam or clay loam

Bk horizon:
Texture: sandy loam, fine sandy loam, loam or clay loam

2Cg horizon:
Texture: loamy sand, fine sand, fine sandy loam or sandy loam

Arvilla Series

Depth class: Very deep
Drainage class: Somewhat excessively drained
Permeability: Moderately rapid over rapid or very rapid
Landform: Outwash plains and till plains
Parent material: Glacial outwash
Slope: 0 to 6 percent

Taxonomic class: Sandy, mixed Udic Haploborolls

Typical pedon: (Outside Towner County)
Arvilla sandy loam, 1,850 feet south and 1,320 feet east of the northwest corner of sec 6, T. 161 N., R. 72 W.

Ap—0 to 5 inches; black (10YR 2/1), broken face, sandy loam, very dark gray (10YR 3/1), broken face, dry; weak medium granular and weak fine granular structure; soft, very friable, slightly sticky and slightly plastic; common very fine roots throughout; 5 percent mixed gravel; neutral; clear smooth boundary.

A—5 to 10 inches; black (10YR 2/1), broken face, sandy loam, very dark gray (10YR 3/1), broken face, dry; moderate medium subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; common very fine roots throughout; 5 percent mixed gravel; neutral; gradual wavy boundary.

Bw—10 to 16 inches; brown (10YR 4/3), broken face, sandy loam, brown (10YR 5/3) dry; weak medium prismatic structure parting to moderate medium subangular blocky; soft, very friable, slightly sticky and slightly plastic; common very fine roots throughout; 5 percent mixed gravel; neutral; abrupt smooth boundary.

2Bk—16 to 31 inches; brown (10YR 4/3) gravelly coarse sand, pale brown (10YR 6/3) dry; single grain; loose, nonsticky and nonplastic; few very fine roots throughout; masses of lime located on undersides of pebbles; strongly effervescent throughout (HCl, unspecified); 30 percent mixed gravel; slightly alkaline; gradual wavy boundary.

2C—31 to 60 inches; brown (10YR 4/3) gravelly coarse sand, pale brown (10YR 6/3) dry; single grain; loose, nonsticky and nonplastic; slightly effervescent throughout (HCl, unspecified); 30 percent mixed gravel; slightly alkaline.

Range in Characteristics

Mollic epipedon thickness: 7 to 20 inches
Depth to lime: 13 to 25 inches
Depth to sand and gravel: 14 to 25 inches
Notes: Some pedons have loamy sand or sandy loam Bk horizons.

Bw horizon:
Notes: 0 to 10 percent gravel

2Bk and 2C horizons:
Notes: They have more than 5 percent gravel and average 20 to 35 percent gravel.

Barnes Series

Depth class: Very deep
Drainage class: Well drained
Permeability: Moderately slow
Landform: Till plains
Parent material: Glacial till
Slope: 0 to 15 percent

Taxonomic class: Fine-loamy, mixed, superactive Udic Haploborolls

Typical Pedon
Barnes loam, in an area of Barnes-Svea loams, 0 to 3 percent slopes, 2,300 feet south and 300 feet west of the northeast corner of sec. 28, T. 163 N., R. 67 W.

Ap—0 to 6 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure parting to weak fine granular; slightly hard, friable, slightly sticky and slightly plastic; few very fine and fine roots; many fine pores; neutral; clear wavy boundary.

Bw1—6 to 10 inches; dark brown (10YR 3/3) loam, brown (10YR 4/3) dry; moderate medium prismatic structure parting to moderate medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; few very fine and fine roots; common fine pores; neutral; clear wavy boundary.

Bw2—10 to 18 inches; brown (10YR 5/3) loam, pale brown (10YR 6/3) dry; weak fine prismatic structure parting to moderate medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; common fine pores; slightly effervescent in the lower part; slightly alkaline; 1 percent mixed gravel; gradual wavy boundary.

Bk—18 to 25 inches; light yellowish brown (2.5Y 6/4) loam, pale yellow (2.5Y 7/4) dry; weak fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few very fine and fine roots; few medium pores; moderately alkaline; common fine soft masses of lime

pedogenic; violently effervescent throughout (HCl, unspecified); 2 percent mixed gravel; clear wavy boundary.

BCk—25 to 34 inches; light olive brown (2.5Y 5/4) loam, light yellowish brown (2.5Y 6/4) dry; massive; hard, friable, slightly sticky and slightly plastic; few very fine roots; few medium pores; moderately alkaline; common fine soft masses of lime pedogenic; violently effervescent throughout (HCl, unspecified); 2 percent mixed gravel; gradual wavy boundary.

C—34 to 60 inches; olive brown (2.5Y 4/4) loam, light olive brown (2.5Y 5/4) dry; massive; hard, friable, slightly sticky and slightly plastic; moderately alkaline; few medium soft masses of lime pedogenic; strongly effervescent throughout (HCl, unspecified); 2 percent mixed gravel.

Range in Characteristics

Mollic epipedon thickness: 7 to 16 inches

Ap horizon:
Value: 3 or 4 dry

Bw horizon:
Hue: 10YR or 2.5Y
Value: 4 to 6 dry
Chroma: 2 to 4
Texture: loam or clay loam

Bk horizon:
Hue: 2.5Y or 10YR
Value: 4 to 6, 6 to 8 dry
Chroma: 2 to 4
Texture: loam or clay loam

BCk horizon:
Notes: Some pedons do not have a BCk horizon.

C horizon:
Value: 4 or 5, 5 to 7 dry
Chroma: 2 to 4
Texture: loam or clay loam

Bearden Series

Depth class: Very deep
Drainage class: Somewhat poorly drained
Permeability: Moderately slow
Landform: Lake plains
Parent material: Glaciolacustrine deposits
Slope: 0 to 1 percent
Notes: These soils are highly calcareous.

Taxonomic class: Fine-silty, mixed, superactive, frigid Aeric Calciaquolls

Typical Pedon
Bearden silt loam, 1,200 feet north and 2,200 feet east of the southwest corner of sec. 17, T. 158 N., R. 66 W.

Ap—0 to 7 inches; black (10YR 2/1) silt loam, very dark gray (10YR 3/1) dry; moderate fine subangular blocky structure parting to moderate fine granular; hard, friable, moderately sticky and slightly plastic; common fine and very fine roots; many fine pores; slightly alkaline; strongly effervescent throughout (HCl, unspecified); abrupt smooth boundary.

ABk—7 to 12 inches; dark gray (10YR 4/1) silty clay loam, gray (10YR 6/1) dry; weak medium subangular blocky structure parting to weak fine granular; hard, friable, moderately sticky and moderately plastic; common fine roots; many fine pores; slightly alkaline; violently effervescent throughout (HCl, unspecified); clear wavy boundary.

Bk—12 to 22 inches; dark grayish brown (2.5Y 4/2) silty clay loam, light brownish gray (2.5Y 6/2) dry; moderate medium subangular blocky structure; hard, friable, moderately sticky and moderately plastic; few very fine roots; many fine pores; moderately alkaline; few fine soft masses of lime pedogenic; violently effervescent throughout (HCl, unspecified); clear wavy boundary.

C1—22 to 29 inches; light yellowish brown (2.5Y 6/4) silt loam, pale yellow (2.5Y 7/4) dry; massive; hard, friable, moderately sticky and moderately plastic; few fine pores; slightly alkaline; strongly effervescent throughout (HCl, unspecified); clear wavy boundary.

C2—29 to 60 inches; light yellowish brown (2.5Y 6/4) silt loam, pale yellow (2.5Y 7/4) dry; massive; hard, firm, moderately sticky and moderately plastic; slightly alkaline; common fine and medium prominent gray (10YR 6/1) iron depletions pedogenic and common fine and medium prominent yellowish brown (10YR 5/6) masses of iron accumulation pedogenic; strongly effervescent throughout (HCl, unspecified).

Range in Characteristics

Mollic epipedon thickness: 7 to 20 inches
Salinity: The soil is saline in some map units.
Notes: Some pedons do not have an ABk horizon.

Ap horizon:
Hue: 10YR or 2.5Y
Value: 2 or 3, 3 to 5 dry or neutral
Chroma: 0 or 1

Bk horizon:
Hue: 10YR, 2.5Y or 5Y
Value: 3 to 5, 5 to 7 dry
Chroma: 1 to 4
Texture: silt loam or silty clay loam

C horizon:
Value: 4 to 6, 5 to 7 dry
Chroma: 2 to 4
Texture: silty clay loam or silt loam

Binford Series

Depth class: Very deep
Drainage class: Somewhat excessively drained
Permeability: Moderately rapid
Landform: Outwash plains
Parent material: Glaciofluvial deposits
Slope: 0 to 15 percent

Taxonomic class: Sandy, mixed Udic Haploborolls

Typical Pedon
Binford sandy loam, in an area of Binford-Coe sandy loams, 0 to 6 percent slopes, 100 feet north and 150 feet west of the southeast corner of sec. 21, T. 163 N., R. 67 W.

A—0 to 8 inches; black (10YR 2/1) sandy loam, very dark gray (10YR 3/1) dry; moderate medium and coarse granular structure; soft, very friable, slightly sticky and slightly plastic; common very fine and fine roots; neutral; clear irregular boundary.

Bw—8 to 18 inches; brown (10YR 4/3) sandy loam, brown (10YR 5/3) dry; moderate coarse prismatic structure parting to moderate coarse subangular blocky; hard, friable, slightly sticky and slightly plastic; common very fine and few fine roots; slightly alkaline; clear smooth boundary.

2Bk—18 to 23 inches; dark grayish brown (2.5Y 4/2) sand, light brownish gray (2.5Y 6/2) dry; weak fine subangular blocky structure; loose, nonsticky and nonplastic; few very fine and fine roots; moderately alkaline; violently effervescent throughout (HCl, unspecified); 15 percent shale in the 0.1 to 76 mm fraction; gradual smooth boundary.

2C1—23 to 42 inches; brown (10YR 4/3) gravelly coarse sand, pale brown (10YR 6/3) dry; single grain; loose, nonsticky and nonplastic; few very fine roots; slightly alkaline; slightly effervescent throughout (HCl, unspecified); 20 percent mixed gravel; 20 percent shale in the 0.1 to 76 mm fraction; clear smooth boundary.

2C2—42 to 53 inches; brown (10YR 4/3) very gravelly coarse sand, pale brown (10YR 6/3) dry; single grain; loose, nonsticky and nonplastic; moderately alkaline; strongly effervescent throughout (HCl, unspecified); 45 percent mixed gravel; 50 percent shale in the 0.1 to 76 mm fraction; clear smooth boundary.

2C3—53 to 60 inches; brown (10YR 4/3) very gravelly coarse sand, pale brown (10YR 6/3) dry; single grain; loose, nonsticky and nonplastic; slightly alkaline; slightly effervescent throughout (HCl, unspecified); 40 percent mixed gravel; 55 percent shale in the 0.1 to 76 mm fraction.

Range in Characteristics

Mollic epipedon thickness: 7 to 16 inches
Depth to sand and gravel: 14 to 25 inches
Notes: Some pedons have a 2Bw horizon.

A horizon:
Value: 2 or 3, 3 to 5 dry

Bw horizon:
Hue: 10YR or 2.5Y
Value: 2 to 4, 4 to 6 dry
Chroma: 1 to 3

2C horizon:
Hue: 10YR, 2.5Y or 5Y
Value: 3 to 6, 5 to 7 dry
Chroma: 1 to 3
Texture: sand or coarse sand
Notes: It has 20 to 65 percent shale in the 0.1 to 76 mm in fraction. It averages less than 35 percent gravel, however gravel content ranges from 5 to 70 percent.

Brantford Series

Depth class: Very deep
Drainage class: Well drained
Permeability: Moderate over very rapid
Landform: Outwash plains
Parent material: Glaciofluvial deposits
Slope: 1 to 6 percent

Taxonomic class: Fine-loamy over sandy or sandy-skeletal, mixed, superactive Udic Haploborolls

Typical Pedon
Brantford loam, in an area of Brantford-Coe loams, 1 to 6 percent slopes, 2,400 feet north and 250 feet west of the southeast corner of sec. 9, T. 161 N., R. 67 W.

Ap—0 to 9 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak medium granular structure parting to weak fine granular; slightly hard, very friable, slightly sticky and nonplastic; common very fine and fine roots; neutral; 2 percent mixed gravel; clear smooth boundary.

Bw—9 to 15 inches; dark brown (10YR 3/3) loam, brown (10YR 5/3) dry; weak coarse prismatic structure parting to weak fine and medium subangular blocky; slightly hard, very friable, slightly sticky and slightly plastic; few very fine roots; neutral; 7 percent mixed gravel; 15 percent shale in the 0.1 to 76 mm fraction; clear smooth boundary.

2Bw—15 to 19 inches; olive brown (2.5Y 4/3) gravelly loamy sand, light olive brown (2.5Y 5/3) dry; single grain; loose, nonsticky and nonplastic; few very fine roots; slightly alkaline; 20 percent mixed gravel; 15 percent shale in the 0.1 to 76 mm fraction; clear wavy boundary.

2Bk—19 to 28 inches; grayish brown (2.5Y 5/2) very gravelly sand, light brownish gray (2.5Y 6/2) dry; single grain; loose, nonsticky and nonplastic; moderately alkaline; lime coats on lower surfaces of rocks; strongly effervescent throughout (HCl, unspecified); 60 percent mixed gravel; 30 percent shale in the 0.1 to 76 mm fraction; diffuse wavy boundary.

2C—28 to 60 inches; grayish brown (2.5Y 5/2) extremely gravelly sand, light brownish gray (2.5Y 6/2) dry; single grain; loose, nonsticky and nonplastic; moderately alkaline; lime coats on lower surfaces of rocks; slightly effervescent throughout (HCl, unspecified); 70 percent mixed gravel; 30 percent shale in the 0.1 to 76 mm fraction.

Range in Characteristics

Mollic epipedon thickness: 7 to 16 inches
Depth to sand and gravel: 14 to 20 inches

Ap horizon:
Value: 3 or 4 dry

Bw horizon:
Hue: 10YR or 2.5Y
Value: 4 or 5 dry
Chroma: 1 to 3
Texture: loam or gravelly loam

2Bw and 2Bk horizons:
Notes: Some pedons do not have these horizons.

2C horizon:
Notes: 20 to 65 percent shale in the 0.1 to 76 mm fraction. 30 to 75 percent gravel.

Buse Series

Depth class: Very deep
Drainage class: Well drained
Permeability: Moderately slow
Landform: Till plains
Parent material: Glacial till
Slope: 3 to 35 percent
Notes: These soils are highly calcareous.

Taxonomic class: Fine-loamy, mixed, superactive Udic Calciborolls

Typical Pedon
Buse loam, in an area of Barnes-Buse loams, 3 to 6 percent slopes, 950 feet north and 400 feet west of the southeast corner of sec. 25, T. 160 N., R. 67 W.

Ap—0 to 8 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure parting to weak fine granular; slightly hard, friable, slightly sticky and slightly plastic; few very fine and fine roots; slightly alkaline; strongly effervescent throughout (HCl, unspecified); 2 percent mixed gravel; abrupt smooth boundary.

Bk—8 to 20 inches; light yellowish brown (2.5Y 6/3) loam, white (2.5Y 8/2) dry; weak fine prismatic structure parting to moderate fine subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; few very fine and fine roots; moderately alkaline; violently effervescent throughout (HCl, unspecified); 2 percent mixed gravel; gradual irregular boundary.

C—20 to 60 inches; light olive brown (2.5Y 5/4) loam, pale yellow (2.5Y 7/3) dry; massive; slightly hard, friable, slightly sticky and slightly plastic; moderately alkaline; strongly effervescent throughout (HCl, unspecified); 2 percent mixed gravel.

Range in Characteristics

Mollic epipedon thickness: 7 to 10 inches

Ap horizon:
Value: 2 or 3, 3 or 4 dry

Bk horizon:
Value: 4 to 6, 6 to 8 dry
Chroma: 3 or 4
Texture: loam or clay loam

C horizon:
Value: 4 to 6, 6 or 7 dry
Chroma: 2 to 4
Texture: loam or clay loam

Coe Series

Depth class: Very deep
Drainage class: Excessively drained
Permeability: Moderate over very rapid
Landform: Outwash plains
Parent material: Glaciofluvial deposits
Slope: 0 to 15 percent

Taxonomic class: Sandy-skeletal, mixed Udorthentic Haploborolls

Typical Pedon
Coe loam, in an area of Brantford-Coe loams, 1 to 6 percent slopes, 2,400 feet north and 200 feet west of the southeast corner of sec. 9, T. 161 N., R. 67 W.

Ap—0 to 7 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak coarse granular structure parting to weak fine granular; soft, very friable, slightly sticky and nonplastic; common very fine and fine roots; slightly alkaline; slightly effervescent throughout (HCl, unspecified); 10 percent mixed gravel; 5 percent shale in the 0.1 to 76 mm fraction; clear smooth boundary.

Bk1—7 to 13 inches; brown (10YR 5/3) gravelly loamy sand, light brownish gray (10YR 6/2) dry; single grain; loose, nonsticky and nonplastic; few very fine roots; moderately alkaline; lime coats on lower surfaces of rocks; strongly effervescent throughout (HCl, unspecified); 25 percent mixed gravel; 20 percent shale in the 0.1 to 76 mm fraction; gradual wavy boundary.

Bk2—13 to 24 inches; grayish brown (2.5Y 5/2) very gravelly sand, light brownish gray (2.5Y 6/2) dry; single grain; loose, nonsticky and nonplastic; few very fine roots; moderately alkaline; lime coats on lower surfaces of rocks; strongly effervescent throughout (HCl, unspecified); 45 percent mixed gravel; 35 percent shale in the 0.1 to 76 mm fraction; diffuse wavy boundary.

C—24 to 60 inches; light olive brown (2.5Y 5/3) extremely gravelly coarse sand, light gray (2.5Y 7/2) dry; single grain; loose, nonsticky and nonplastic; slightly alkaline; slightly effervescent throughout (HCl, unspecified); 70 percent mixed gravel; 60 percent shale in the 0.1 to 76 mm fraction.

Range in Characteristics

Depth to sand and gravel: 6 to 14 inches

Ap horizon:
Value: 3 or 4 dry
Texture: loam or sandy loam

C horizon:
Hue: 2.5Y or 5Y
Value: 4 or 5, 5 to 7 dry
Texture: very gravelly or extremely gravelly coarse sand, loamy coarse sand or sand
Notes: It has 20 to 70 percent shale in the 0.1 to 76 mm fraction. It has 35 to 70 percent gravel.

Colvin Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Moderately slow
Landform: Lake plains and till plains
Parent material: Alluvium and glaciolacustrine deposits
Slope: 0 to 1 percent
Notes: These soils are highly calcareous.

Taxonomic class: Fine-silty, mixed, superactive, frigid Typic Calciaquolls

Typical Pedon
Colvin silt loam, 1,050 feet south and 1,890 feet east of the northwest corner of sec. 6, T. 163 N., R. 66 W.

A—0 to 11 inches; black (10YR 2/1) silt loam, very dark gray (10YR 3/1) dry; moderate medium subangular blocky structure parting to weak fine subangular blocky; soft, friable, slightly sticky and slightly plastic; many very fine and few fine roots; moderately alkaline; violently effervescent throughout (HCl, unspecified); gradual wavy boundary.

Bkg1—11 to 19 inches; gray (5Y 5/1) and dark gray (5Y 4/1) silt loam, light gray (5Y 7/1) and gray (5Y 5/1) dry; moderate coarse prismatic structure parting to moderate medium and coarse subangular blocky; hard, friable, moderately sticky and moderately plastic; common very fine and few fine roots; moderately alkaline; violently effervescent throughout (HCl, unspecified); clear wavy boundary.

Bkg2—19 to 29 inches; olive gray (5Y 5/2) silt loam, pale yellow (5Y 8/2) dry; weak coarse prismatic structure parting to moderate coarse subangular blocky; hard, friable, moderately sticky and slightly plastic; few very fine roots; moderately alkaline; few coarse faint olive (5Y 5/3) masses of iron accumulation pedogenic; violently effervescent throughout (HCl, unspecified); clear wavy boundary.

Bkg3—29 to 43 inches; olive gray (5Y 5/2) silt loam, light gray (5Y 7/2) dry; weak coarse prismatic structure parting to moderate coarse subangular blocky; hard, friable, moderately sticky and slightly plastic; moderately alkaline; common fine distinct olive (5Y 5/4) masses of iron accumulation pedogenic; violently effervescent throughout (HCl, unspecified); clear smooth boundary.

BCg—43 to 54 inches; olive gray (5Y 5/2) silt loam, light gray (5Y 7/2) dry; weak medium subangular blocky structure parting to weak fine subangular blocky; hard, friable, moderately sticky and slightly plastic; moderately alkaline; many fine prominent olive brown (2.5Y 4/4) masses of iron accumulation pedogenic; strongly effervescent throughout (HCl, unspecified); gradual wavy boundary.

Cg—54 to 60 inches; olive gray (5Y 5/2) silt loam, light gray (5Y 7/2) dry; massive; hard, friable, slightly sticky and slightly plastic; moderately alkaline; many coarse distinct olive (5Y 5/4) masses of iron accumulation pedogenic; strongly effervescent throughout (HCl, unspecified).

Range in Characteristics

Mollic epipedon thickness: 7 to 24 inches
Salinity: The soil is saline in some pedons.
Notes: Some pedons have Ak or ABk horizons.

Ap horizon:
Hue: 10YR, 2.5Y, 5Y or neutral
Value: 2 or 3, 3 or 4 dry
Chroma: 0 or 1

Bkg horizon:
Hue: 10YR, 2.5Y, 5Y or neutral
Value: 3 to 6
Chroma: 0 to 2

Cg horizon:
Hue: 2.5Y or 5Y
Value: 3 to 6, 5 to 7 dry
Chroma: 1 to 4

Cresbard Series

Depth class: Very deep
Drainage class: Moderately well drained
Permeability: Slow
Landform: Till plains
Parent material: Glacial till
Slope: 0 to 3 percent
Notes: These soils are sodic.

Taxonomic class: Fine, smectitic Glossic Udic Natriborolls

Typical Pedon
Cresbard loam, in an area of Hamerly-Cresbard loams, 0 to 3 percent slopes, 2,410 feet south and 1,560 feet west of the northeast corner of sec. 14, T. 163 N., R. 65 W.

Ap—0 to 5 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak medium subangular blocky structure parting to moderate fine granular; soft, very friable, slightly sticky and slightly plastic; common very fine roots; neutral; 1 percent mixed gravel; clear smooth boundary.

A—5 to 10 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; moderate coarse prismatic structure parting to moderate medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; neutral; 1 percent mixed gravel; abrupt smooth boundary.

E—10 to 12 inches; very dark gray (10YR 3/1) loam, gray (10YR 5/1) dry; strong very thin platy structure; hard, friable, slightly sticky and slightly plastic; common very fine roots; few very fine discontinuous tubular pores; neutral; 1 percent mixed gravel; abrupt wavy boundary.

B/E—12 to 15 inches; black (10YR 2/1) clay loam, very dark gray (10YR 3/1) dry (B); very dark gray (10YR 3/1) clay loam, gray (10YR 5/1) dry (E); moderate coarse prismatic structure parting to strong fine angular blocky; very hard, very firm, very sticky and very plastic; common very fine roots; few very fine discontinuous tubular pores; neutral; prominent continuous clay films on faces

of peds; 1 percent mixed gravel; clear wavy boundary.

Btn—15 to 22 inches; black (10YR 2/1) clay loam, very dark gray (10YR 3/1) dry; moderate coarse prismatic structure parting to strong very fine angular blocky; very hard, very firm, very sticky and very plastic; few very fine roots; few very fine discontinuous tubular pores; neutral; prominent continuous clay films on faces of peds; 1 percent mixed gravel; clear wavy boundary.

Btkn—22 to 29 inches; very dark grayish brown (2.5Y 3/2) clay loam, grayish brown (2.5Y 5/2) dry; moderate very fine subangular blocky structure; very hard, firm, moderately sticky and moderately plastic; few very fine roots; moderately alkaline; distinct continuous clay films on faces of peds; common fine soft masses of lime pedogenic; slightly effervescent throughout (HCl, unspecified); 5 percent mixed gravel; gradual smooth boundary.

Bk—29 to 37 inches; dark grayish brown (2.5Y 4/2) loam, light brownish gray (2.5Y 6/2) dry; weak medium subangular blocky structure; hard, firm, slightly sticky and slightly plastic; moderately alkaline; many fine soft masses of lime pedogenic and common fine faint olive brown (2.5Y 4/3) masses of iron accumulation pedogenic; slightly effervescent throughout (HCl, unspecified); 5 percent mixed gravel; clear smooth boundary.

C—37 to 60 inches; olive brown (2.5Y 4/4) clay loam, light yellowish brown (2.5Y 6/4) dry; massive; hard, firm, moderately sticky and moderately plastic; moderately alkaline; common medium soft masses of lime pedogenic and common fine distinct grayish brown (2.5Y 5/2) iron depletions pedogenic; strongly effervescent throughout (HCl, unspecified); 5 percent mixed gravel.

Range in Characteristics

Depth to lime: 15 to 30 inches

A horizon:
Value: 2 or 3, 3 or 4 dry

E horizon:
Value: 2 or 3
Texture: loam or silt loam
Notes: Some pedons do not have an E horizon.

Bt horizon:
Value: 2 to 4
Chroma: 1 to 3
Texture: clay loam or clay

Bk horizon:
Value: 4 to 6, 5 to 7 dry
Chroma: 2 to 4
Texture: clay loam or loam

C horizon:
Value: 4 to 6, 5 to 7 dry
Chroma: 2 to 4
Texture: loam or clay loam

Divide Series

Depth class: Very deep
Drainage class: Somewhat poorly drained
Permeability: Moderate over very rapid
Landform: Outwash plains
Parent material: Glaciofluvial deposits
Slope: 0 to 3 percent
Notes: These soils are highly calcareous.

Taxonomic class: Fine-loamy over sandy or sandy-skeletal, mixed, superactive, frigid Aeric Calciaquolls

Typical Pedon
Divide loam, 0 to 3 percent slopes, 2,300 feet east, 200 feet north of the southwest corner of sec. 17, T. 159 N., R. 68 W.

Ap—0 to 7 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak fine granular structure; slightly hard, friable, moderately sticky and moderately plastic; many very fine and fine roots; slightly alkaline; strongly effervescent throughout (HCl, unspecified); 2 percent mixed gravel; gradual wavy boundary.

ABk—7 to 14 inches; very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; weak medium subangular blocky structure parting to weak medium granular; slightly hard, friable, moderately sticky and moderately plastic; common very fine and fine roots; slightly alkaline; many fine soft masses of lime pedogenic; strongly effervescent throughout (HCl, unspecified); 5 percent mixed gravel; clear wavy boundary.

Bk1—14 to 25 inches; light brownish gray (2.5Y 6/2) loam, light gray (2.5Y 7/2) dry; weak medium prismatic structure parting to weak fine subangular blocky; slightly hard, friable, moderately sticky and moderately plastic; few very fine roots; moderately alkaline; violently effervescent throughout (HCl, unspecified); 10 percent mixed gravel; clear smooth boundary.

2Bk2—25 to 30 inches; grayish brown (2.5Y 5/2) very gravelly loamy sand, light gray (2.5Y 7/2) dry; single grain; loose, nonsticky and nonplastic; moderately alkaline; lime coats on lower surfaces of peds or rocks; violently effervescent throughout (HCl, unspecified); 40 percent mixed gravel; 5 percent shale in the 0.1 to 76 mm fraction; clear wavy boundary.

2C—30 to 60 inches; dark grayish brown (2.5Y 4/2) gravelly coarse sand, light brownish gray (2.5Y 6/2) dry; single grain; loose, nonsticky and nonplastic; slightly alkaline; strongly effervescent throughout (HCl, unspecified); 30 percent mixed gravel; 15 percent shale in the 0.1 to 76 mm fraction.

Range in Characteristics

Mollic epipedon thickness: 7 to 20 inches
Depth to sand and gravel: 20 to 35 inches

Ap horizon:
Hue: 10YR or 2.5Y
Value: 2 or 3, 3 to 5 dry

ABk horizon:
Notes: Some pedons do not have an ABk horizon.

Bk horizon:
Hue: 10YR, 2.5Y or 5Y
Value: 3 to 6, 5 to 8 dry
Chroma: 1 to 4
Texture: loam, gravelly loam, clay loam

2C horizon:
Hue: 10YR, 2.5Y or 5Y
Value: 4 or 5, 5 to 7 dry
Chroma: 2 to 6
Notes: It has 5 to 25 percent shale in the 0.1 to 76 mm fraction. It has 15 to 35 percent gravel.

Dovray Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Slow or very slow
Landform: Lake plains
Parent material: Glaciolacustrine deposits
Slope: 0 to 1 percent

Taxonomic class: Fine, smectitic, frigid Cumulic Vertic Epiaquolls

Typical pedon: (Outside Towner County)
Dovray clay, 900 feet south and 25 feet west of the northeast corner of sec. 22, T. 118 N., R. 43 W.

Ap—0 to 10 inches; black (N 2/0), broken face, clay; moderate fine subangular blocky structure; hard; slightly alkaline; clear smooth boundary.

A—10 to 33 inches; black (N 2/0), broken face, clay; moderate very fine angular blocky structure; firm; few gypsum crystals pedogenic at top of horizon; few fine distinct dark yellowish brown (10YR 4/4) masses of iron accumulations pedogenic throughout; neutral; gradual smooth boundary.

ABg—33 to 43 inches; very dark gray (5Y 3/1), broken face, clay; moderate very fine angular blocky structure; firm; neutral; gradual smooth boundary.

Bg—43 to 56 inches; olive gray (5Y 5/2), broken face, clay; moderate fine subangular blocky structure; firm; many medium prominent dark yellowish brown (10YR 4/4) and many medium prominent brown (7.5YR 4/4) masses of iron accumulation pedogenic throughout; neutral; clear smooth boundary.

Cg—56 to 60 inches; light olive gray (5Y 6/2) clay; massive; firm; few lime threads pedogenic throughout; many fine prominent dark yellowish brown (10YR 4/4) masses of iron accumulations pedogenic throughout; slightly alkaline.

Range in Characteristics

Mollic epipedon thickness: 24 to 54 inches
Depth to lime: 20 to 60 inches
Notes: Some pedons have an 0 horizon up to 4 inches thick.

Eckman Series

Depth class: Very deep
Drainage class: Well drained
Permeability: Moderate
Landform: Lake plains
Parent material: Glaciolacustrine deposits
Slope: 0 to 3 percent

Taxonomic class: Coarse-silty, mixed, superactive Udic Haploborolls

Typical pedon: (Outside Towner County)
Eckman silt loam, 1,735 feet east and 495 feet north of the southwest corner of sec. 32, T. 126 N., R. 51 W.

Ap—0 to 8 inches; very dark gray (10YR 3/1), broken face, silt loam, dark gray (10YR 4/1), broken face, dry; weak medium subangular blocky structure; friable, slightly sticky and slightly plastic; slightly acid; abrupt smooth boundary.

Bw1—8 to 13 inches; grayish brown (10YR 5/2), broken face, silt loam, dark grayish brown (10YR 4/2), broken face, dry; weak coarse prismatic structure; friable, slightly sticky and slightly plastic; slightly acid; gradual wavy boundary.

Bw2—13 to 19 inches; dark grayish brown (10YR 4/2), broken face, silt loam, grayish brown (10YR 5/2), broken face, dry; weak coarse prismatic structure; friable, slightly sticky and slightly plastic; slightly acid; clear wavy boundary.

Bk—19 to 40 inches; light olive brown (2.5Y 5/4), broken face, silt loam, pale yellow (2.5Y 7/4), broken face, dry; weak medium subangular blocky structure; friable, slightly sticky and slightly plastic; strongly effervescent throughout (HCl, unspecified); neutral; gradual wavy boundary.

C1—40 to 48 inches; light olive brown (2.5Y 5/4), broken face, silt loam, pale yellow (2.5Y 7/4), broken face, dry; weak medium subangular blocky structure; friable, slightly sticky and slightly plastic; slightly effervescent throughout (HCl, unspecified); neutral; clear wavy boundary.

C2—48 to 60 inches; light olive brown (2.5Y 5/4) very fine sandy loam, pale yellow (2.5Y 7/4) dry; massive; very friable, slightly sticky and slightly plastic; slightly effervescent throughout (HCl, unspecified); neutral.

Range in Characteristics

Mollic epipedon thickness: 7 to 16 inches
Depth to lime: 10 to 36 inches

Egeland Series

Depth class: Very deep
Drainage class: Well drained
Permeability: Moderately rapid
Landform: Delta plains
Parent material: Glaciolacustrine deposits
Slope: 0 to 3 percent

Taxonomic class: Coarse-loamy, mixed, superactive Udic Haploborolls

Typical Pedon
Egeland fine sandy loam, in an area of Egeland-Embden fine sandy loams, 0 to 3 percent slopes, 2,220 feet north and 630 feet west of the southeast corner of sec. 32, T. 158 N., R. 65 W.

Ap—0 to 7 inches; black (10YR 2/1) fine sandy loam, dark gray (10YR 4/1) dry; weak fine and medium subangular blocky structure parting to weak fine granular; slightly hard, very friable, slightly sticky and slightly plastic; many very fine, fine, medium and coarse roots; neutral; abrupt wavy boundary.

Bw—7 to 15 inches; olive brown (2.5Y 4/3) fine sandy loam, light olive brown (2.5Y 5/3) dry; weak medium subangular blocky structure parting to weak fine subangular blocky; slightly hard, very friable, slightly sticky and slightly plastic; many very fine and fine roots; tongues of A horizon material extend 4 to 5 inches into the upper part; neutral; clear wavy boundary.

Bk1—15 to 26 inches; light olive brown (2.5Y 5/3) fine sandy loam, light yellowish brown (2.5Y 6/3) dry; weak medium subangular blocky structure parting to weak fine subangular blocky; slightly hard, very friable, nonsticky and nonplastic; many very fine and fine roots; slightly alkaline; strongly effervescent throughout (HCl, unspecified); clear wavy boundary.

Bk2—26 to 44 inches; light olive brown (2.5Y 5/3) loamy fine sand, pale yellow (2.5Y 7/3) dry; weak coarse subangular blocky structure parting to weak medium subangular blocky; soft, very friable, nonsticky and nonplastic; few very fine roots; slightly alkaline; common fine and medium soft masses of lime pedogenic; slightly effervescent throughout (HCl, unspecified); clear wavy boundary.

C—44 to 60 inches; light olive brown (2.5Y 5/3) loamy sand, light yellowish brown (2.5Y 6/3) dry; massive; soft, very friable, nonsticky and nonplastic; few very fine roots; moderately alkaline; slightly effervescent throughout (HCl, unspecified).

Range in Characteristics

Mollic epipedon thickness: 7 to 16 inches

Ap horizon:
Value: 2 or 3, 3 or 4 dry

Bw horizon:
Value: 2 to 5, 4 to 6 dry
Chroma: 1 to 4

Bk horizon:
Value: 4 or 5
Chroma: 2 to 4

C horizon:
Value: 4 or 5, 6 or 7 dry
Chroma: 2 to 4
Texture: fine sandy loam, sandy loam or loamy sand

Embden Series

Depth class: Very deep
Drainage class: Moderately well drained
Permeability: Moderately rapid
Landform: Delta plains
Parent material: Glaciolacustrine deposits
Slope: 0 to 3 percent

Taxonomic class: Coarse-loamy, mixed, superactive Pachic Udic Haploborolls

Typical Pedon
Embden fine sandy loam, in an area of Egeland-Embden fine sandy loams, 0 to 3 percent slopes, 2,600 feet south and 720 feet west of the northeast corner of sec. 32, T. 158 N., R. 65 W.

Ap—0 to 7 inches; black (10YR 2/1) fine sandy loam, very dark gray (10YR 3/1) dry; weak medium subangular blocky structure parting to weak fine granular; slightly hard, very friable, slightly sticky and nonplastic; common very fine and fine roots; neutral; abrupt smooth boundary.

A—7 to 14 inches; black (10YR 2/1) fine sandy loam, very dark gray (10YR 3/1) dry; weak coarse prismatic structure parting to weak fine subangular blocky; slightly hard, very friable, slightly sticky and nonplastic; common very fine and fine roots; neutral; clear wavy boundary.

Bw1—14 to 20 inches; very dark grayish brown (10YR 3/2) fine sandy loam, dark grayish brown (10YR 4/2) dry; weak medium prismatic structure parting to weak medium subangular blocky; slightly hard, very friable, slightly sticky and nonplastic; few very fine and fine roots; neutral; clear wavy boundary.

Bw2—20 to 28 inches; dark grayish brown (2.5Y 4/2) fine sandy loam, light olive brown (2.5Y 5/3) dry; weak medium subangular blocky structure parting to weak fine subangular blocky; slightly hard, very friable, nonsticky and nonplastic; few very fine roots; neutral; abrupt wavy boundary.

Bk—28 to 38 inches; olive brown (2.5Y 4/3) fine sandy loam, light brownish gray (2.5Y 6/2) dry; weak medium subangular blocky structure parting to weak fine subangular blocky; slightly hard, very friable, slightly sticky and nonplastic; few very fine roots; slightly alkaline; strongly effervescent throughout (HCl, unspecified); clear wavy boundary.

C—38 to 60 inches; olive brown (2.5Y 4/3) loamy fine sand, light yellowish brown (2.5Y 6/3) dry; massive; soft, very friable, nonsticky and nonplastic; moderately alkaline; few fine distinct dark yellowish brown (10YR 4/4) masses of iron accumulation pedogenic; strongly effervescent throughout (HCl, unspecified).

Range in Characteristics

Mollic epipedon thickness: 16 to 36 inches
Depth to lime: 20 to 54 inches

A horizon:
Value: 2 or 3, 3 or 4 dry

Bw horizon:
Value: 2 to 4, 3 to 5 dry
Chroma: 1 to 3

C horizon:
Hue: 2.5Y or 10YR
Value: 4 to 6, 5 to 7 dry
Chroma: 1 to 4
Texture: fine sandy loam or loamy fine sand

Exline Series

Depth class: Very deep
Drainage class: Somewhat poorly drained
Permeability: Very slow
Landform: Lake plains
Parent material: Glaciolacustrine deposits
Slope: 0 to 1 percent
Notes: These soils are saline-sodic.

Taxonomic class: Fine, smectitic Leptic Natriborolls

Typical pedon: (Outside Towner County)
Exline silt loam, 484 feet south and 120 feet east of the northwest corner of sec. 11, T. 122 N., R. 64 W.

A—0 to 2 inches; black (10YR 2/1), broken face, silt loam, dark gray (10YR 4/1), broken face, dry; weak fine granular and weak very fine granular structure; soft, friable, slightly sticky; slightly acid; clear smooth boundary.

E—2 to 3 inches; very dark gray (10YR 3/1), broken face, silt loam, gray (10YR 5/1), broken face, dry; weak very thin platy structure; soft, friable,

slightly sticky; slightly acid; abrupt smooth boundary.

Btn—3 to 7 inches; black (10YR 2/1), broken face, clay, dark gray (10YR 4/1) dry; strong medium columnar structure parting to strong fine and medium subangular blocky; very hard, very firm, very sticky and very plastic; gray (10YR 5/1) dry skeletans on tops of columns and on faces of peds; continuous clay films on vertical faces of peds; neutral; clear wavy boundary.

Btnz—7 to 11 inches; black (10YR 2/1), broken face, and very dark brown (10YR 2/2), broken face, clay, dark gray (10YR 4/1), crushed, dry; moderate medium prismatic structure parting to strong very fine and fine subangular blocky; very hard, very firm, very sticky and very plastic; continuous clay films on vertical faces of peds; common fine and medium salt masses pedogenic throughout; moderately alkaline; gradual wavy boundary.

Btknz—11 to 19 inches; very dark gray (10YR 3/1), broken face, clay, gray (10YR 5/1), broken face, dry; weak very coarse prismatic structure parting to moderate very fine subangular blocky and moderate fine subangular blocky; very hard, very firm, very sticky and very plastic; continuous clay films on vertical faces of peds; many fine and medium salt masses pedogenic throughout; common fine masses of lime pedogenic throughout; strongly effervescent throughout, (HCl, unspecified); moderately alkaline; gradual wavy boundary.

Bkz—19 to 23 inches; grayish brown (2.5Y 5/2), broken face, clay, light brownish gray (2.5Y 6/2), broken face, dry; weak very fine subangular blocky structure; very hard, very firm, very sticky and very plastic; common fine salt masses pedogenic throughout; common fine and medium masses of lime pedogenic throughout; common fine tongues of very dark brown (10YR 2/2) moist; strongly effervescent throughout, (HCl, unspecified); strongly alkaline; gradual wavy boundary.

Bk—23 to 34 inches; grayish brown (2.5Y 5/2), broken face, silty clay loam, light brownish gray (2.5Y 6/2), broken face, dry; weak very fine and fine subangular blocky structure; very hard, firm, moderately sticky and moderately plastic; many coarse tongues of very dark grayish brown (2.5Y 3/2) moist; few fine salt masses pedogenic throughout; few fine masses of lime pedogenic throughout; common fine prominent yellowish brown (10YR 5/6) masses of iron accumulation pedogenic and common fine distinct gray (5Y 5/1) iron depletions pedogenic throughout; strongly effervescent throughout, (HCl, unspecified); strongly alkaline; gradual wavy boundary.

C—34 to 60 inches; light olive brown (2.5Y 5/4) silty clay loam, light gray (2.5Y 7/2) dry; massive; firm, moderately sticky and moderately plastic; common fine and medium masses of lime pedogenic at top of horizon; many fine and medium prominent yellowish brown (10YR 5/6) masses of iron accumulations pedogenic and many fine and medium prominent gray (5Y 5/1) iron depletions pedogenic throughout; strongly effervescent throughout (HCl, unspecified); moderately alkaline.

Range in Characteristics

Depth to lime: 8 to 28 inches
Depth to gypsum or other salts: 6 to 16 inches
Exchangeable sodium percentage: Greater than 15 percent above a depth of 16 inches

E horizon:

Notes: The E horizon is commonly absent in cultivated pedons.

Bt horizon:

Notes: The clay content ranges from 35 to 55 percent.

Fargo Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Slow
Landform: Lake plains
Parent material: Glaciolacustrine deposits
Slope: 0 to 1 percent

Taxonomic class: Fine, smectitic, frigid Typic Epiaquerts

Typical Pedon

Fargo silty clay, in an area of Hegne-Fargo silty clays, 2,600 feet south and 1,900 feet east of the northwest corner of sec. 35, T. 157 N., R. 66 W.

Ap—0 to 8 inches; black (10YR 2/1) silty clay, very dark gray (10YR 3/1) dry; moderate fine subangular blocky structure parting to strong fine granular; very hard, friable, very sticky and very plastic; common very fine roots; neutral; abrupt smooth boundary.

Bw—8 to 18 inches; black (10YR 2/1) silty clay, very dark gray (10YR 3/1) dry; moderate medium subangular blocky structure parting to strong very fine angular blocky; very hard, firm, very sticky and very plastic; few very fine roots; cracks filled with A horizon material extend throughout; slightly alkaline; abrupt smooth boundary.

Bkg—18 to 35 inches; dark gray (5Y 4/1) silty clay, gray (5Y 5/1) dry; weak medium subangular blocky structure parting to weak fine subangular blocky; very hard, friable, moderately sticky and moderately plastic; cracks filled with A horizon material extend throughout; moderately alkaline; few fine irregular soft masses of lime pedogenic and common medium prominent light yellowish brown (2.5Y 6/4) masses of iron accumulation pedogenic; strongly effervescent throughout (HCl, unspecified); abrupt smooth boundary.

Cg1—35 to 46 inches; olive gray (5Y 5/2) clay, gray (5Y 6/1) dry; massive; very hard, firm, moderately sticky and moderately plastic; moderately alkaline; many medium prominent light yellowish brown (2.5Y 6/4) masses of iron accumulation pedogenic; strongly effervescent throughout (HCl, unspecified); gradual wavy boundary.

Cg2—46 to 60 inches; olive gray (5Y 4/2) clay, light olive gray (5Y 6/2) dry; massive; very hard, firm, moderately sticky and moderately plastic; moderately alkaline; strongly effervescent throughout (HCl, unspecified).

Range in Characteristics

Mollic epipedon thickness: 8 to 24 inches
Depth to lime: 11 to 25 inches

Ap horizon:
Hue: 10YR, 2.5Y, 5Y or neutral
Value: 1 or 2, 3 or 4 dry
Chroma: 0 or 1

Bw horizon:
Hue: 10YR, 2.5Y or 5Y
Value: 2 to 4, 3 to 5 dry
Chroma: 1 or 2

Bkg horizon:
Hue: 2.5Y or 5Y
Value: 3 to 6, 5 to 7 dry
Chroma: 1 or 2

Cg horizon:
Hue: 2.5Y or 5Y
Value: 4 to 6, 5 to 8 dry
Chroma: 1 to 3
Notes: It has gypsum crystals in some pedons.

Gardena Series

Depth class: Very deep
Permeability: Moderate
Landform: Lake plains
Parent material: Glaciolacustrine deposits
Slope: 0 to 1 percent

Taxonomic class: Coarse-silty, mixed, superactive frigid, Pachic Haploborolls

Typical pedon: (Outside Towner County) Gardena silt loam, 1,340 feet west and 430 feet north of the southeast corner of sec. 13, T. 158 N., R. 54 W.

Ap—0 to 9 inches; black (10YR 2/1) silt loam, very dark gray (10YR 3/1) dry; weak medium and coarse subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many fine roots; many fine pores; noneffervescent; abrupt smooth boundary.

A—9 to 15 inches; black (10YR 2/1) silt loam, very dark gray (10YR 3/1) dry; weak coarse subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many fine roots; many fine pores; noneffervescent; gradual wavy boundary.

Bw—15 to 22 inches; very dark grayish brown (10YR 3/2) silt loam, dark grayish brown (10YR 4/2) dry; weak medium prismatic structure; hard, friable, slightly sticky and slightly plastic; many fine roots; common pores; noneffervescent; gradual wavy boundary.

Bk—22 to 33 inches; brown (10YR 4/3) silt loam, pale brown (10YR 6/3) dry; weak coarse subangular blocky structure parting to weak fine granular; hard, friable, slightly sticky and slightly plastic; common fine roots; common pores; few fine masses of lime; violently effervescent; diffuse wavy boundary.

C1—33 to 56 inches; brown (10YR 4/3) silt loam, pale brown (10YR 6/3) dry; weak very fine and fine subangular blocky structure; hard, friable, slightly sticky and slightly plastic; common fine roots; common fine pores; krotovinas; few fine grayish brown (2.5Y 5/2) redoximorphic depletions and few fine dark brown (10YR 3/3) redoximorphic concentrations; strongly effervescent; abrupt smooth boundary.

C2—56 to 60 inches; grayish brown (2.5Y 5/2) silt loam, light yellowish brown (2.5Y 6/3) dry;

massive; hard, friable, slightly sticky and nonplastic; many medium dark yellowish brown (10YR 4/4) redoximorphic concentrations; strongly effervescent.

Range in Characteristics

Mollic epipedon thickness: 16 to 40 inches
Depth to lime: 20 to 40 inches

A horizon:
Value: 2 or 3, 3 or 4 dry

Bw horizon:
Hue: 10YR or 2.5Y
Value: 2 to 4, 3 to 5 dry
Chroma: 1 to 3
Texture: silt loam or very fine sandy loam

Bk horizon:
Hue: 10YR, 2.5Y or 5Y
Value: 4 to 6, 5 to 7 dry
Chroma: 2 to 4
Texture: silt loam or very fine sandy loam

C horizon:
Hue: 10YR, 2.5Y or 5Y
Value: 4 to 6, 5 to 7 dry
Chroma: 2 to 4
Texture: silt loam or very fine sandy loam

Glyndon Series

Depth class: Very deep
Drainage class: Somewhat poorly drained
Permeability: Moderate over moderately rapid
Landform: Lake plains
Parent material: Glaciolacustrine deposits
Slope: 0 to 1 percent
Notes: These soils are highly calcareous.

Taxonomic class: Coarse-silty, mixed, superactive, frigid Aeric Calciaquolls

Typical pedon: (Outside Towner County) Glyndon loam, 665 feet east and 210 feet south of the northwest corner of sec. 25, T. 145 N., R. 46 W.

Ap—0 to 8 inches; black (10YR 2/1), broken face, loam, dark gray (10YR 4/1), broken face, dry; weak very fine subangular blocky structure; very friable; many roots throughout; strongly effervescent throughout (HCl, unspecified); moderately alkaline; abrupt smooth boundary.

A—8 to 11 inches; black (10YR 2/1), broken face, loam, dark gray (10YR 4/1), broken face, dry; weak very fine subangular blocky structure; very friable; many roots throughout; strongly effervescent throughout (HCl, unspecified); moderately alkaline; gradual wavy boundary.

Bk1—11 to 16 inches; dark gray (10YR 4/1), broken face, loam; weak very fine subangular blocky structure; very friable; many roots throughout; violently effervescent throughout (HCl, unspecified); moderately alkaline; gradual wavy boundary.

Bk2—16 to 28 inches; light yellowish brown (2.5Y6/3), broken face, loam; weak very fine subangular blocky structure; very friable; few fine faint light yellowish brown (2.5Y 6/4) masses of iron accumulation pedogenic throughout; violently effervescent throughout (HCl, unspecified); moderately alkaline; clear smooth boundary.

C1—28 to 36 inches; light yellowish brown (2.5Y 6/4) loamy very fine sand; massive; very friable; common fine distinct light olive brown (2.5Y 5/6) masses of iron accumulation pedogenic throughout; strongly effervescent throughout (HCl, unspecified); moderately alkaline; gradual smooth boundary.

C2—36 to 60 inches; light brownish gray (2.5Y 6/2) loamy very fine sand; massive; very friable; many medium prominent brownish yellow (10YR 6/8) masses of iron accumulation pedogenic throughout; strongly effervescent throughout (HCl, unspecified) moderately alkaline.

Range in Characteristics

Mollic epipedon thickness: 7 to 16 inches

A horizon:
Texture: loam or silt loam

Bk horizon:
Texture: loam or silt loam

C horizon:
Texture: loamy very fine sand, very fine sandy loam or silt loam

Grano Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Slow
Landform: Lake plains
Parent material: Glaciolacustrine deposits

Slope: 0 to 1 percent
Notes: These soils are calcareous.

Taxonomic class: Fine, smectitic, frigid Typic Endoaquerts

Typical pedon: (Outside Towner County) Grano silty clay, 1,790 feet north and 90 feet east of the southwest corner of sec. 26, T. 135 N., R. 66 W.

Oe—0 to 3 inches; black fibrous peat.

Ag—3 to 19 inches; black (5Y 2/1), broken face, silty clay, dark gray (5Y 4/1), broken face, dry; weak coarse prismatic structure parting to strong fine angular blocky; extremely hard, firm, very sticky and very plastic; many fine roots in upper part and common roots in lower part; few fine lime threads pedogenic throughout; strongly effervescent throughout (HCl, unspecified); moderately alkaline; clear irregular boundary.

Cg1—19 to 39 inches; olive gray (5Y 4/2), broken face, silty clay, light olive gray (5Y 6/2), broken face, dry; strong fine angular blocky structure; extremely hard, firm, very sticky and very plastic; few pores; strongly effervescent throughout (HCl, unspecified); moderately alkaline; gradual wavy boundary.

Cg2—39 to 51 inches; olive gray (5Y 5/2) silty clay, light olive gray (5Y 6/2) dry; massive; extremely hard, firm, very sticky and very plastic; many medium prominent light olive brown (2.5Y 5/6) masses of iron accumulation pedogenic throughout; strongly effervescent throughout (HCl, unspecified); moderately alkaline; gradual wavy boundary.

Cg3—51 to 60 inches; dark gray (5Y 4/1) clay loam, gray (5Y 5/1) dry; massive; extremely hard, firm, moderately sticky and moderately plastic; few fine prominent light olive brown (2.5Y 5/4) masses of iron accumulation pedogenic throughout; 3 percent mixed gravel; slightly effervescent throughout (HCl, unspecified); moderately alkaline.

Range in Characteristics

Mollic epipedon thickness: 7 to 24 inches
10 to 40 inch particle-size control section: averages 50 to 60 percent clay
Notes: The soil is silty clay or clay throughout.

Great Bend Series

Depth class: Very deep
Drainage class: Well drained
Permeability: Moderately slow
Landform: Lake plains
Parent material: Glaciolacustrine deposits
Slope: 0 to 6 percent

Taxonomic class: Fine-silty, mixed, superactive Udic Haploborolls

Typical Pedon
Great Bend silt loam, in an area of Great Bend-Overly silt loams, 0 to 3 percent slopes, 1,200 feet south and 1,800 feet east of the northwest corner of sec. 26, T. 158 N., R. 66 W.

Ap—0 to 6 inches; black (10YR 2/1) silt loam, dark gray (10YR 4/1) dry; weak fine granular structure; slightly hard, very friable, slightly sticky and slightly plastic; neutral; clear wavy boundary.

Bw—6 to 13 inches; dark brown (10YR 3/3) silt loam, brown (10YR 5/3) dry; moderate medium prismatic structure parting to moderate medium subangular blocky; slightly hard, very friable, slightly sticky and slightly plastic; slightly alkaline; clear wavy boundary.

Bk1—13 to 22 inches; olive brown (2.5Y 4/3) silt loam, light yellowish brown (2.5Y 6/3) dry; weak medium prismatic structure parting to weak medium subangular blocky; slightly hard, very friable, slightly sticky and slightly plastic; moderately alkaline; common coarse irregular soft masses of lime pedogenic; strongly effervescent throughout (HCl, unspecified); gradual wavy boundary.

Bk2—22 to 30 inches; light olive brown (2.5Y 5/3) silt loam, pale yellow (2.5Y 7/3) dry; weak medium prismatic structure parting to weak medium subangular blocky; slightly hard, very friable, slightly sticky and slightly plastic; moderately alkaline; common medium irregular soft masses of lime pedogenic; violently effervescent throughout (HCl, unspecified); gradual wavy boundary.

C—30 to 60 inches; olive brown (2.5Y 4/3) silt loam, light yellowish brown (2.5Y 6/3) dry; massive; slightly hard, very friable, slightly sticky and slightly plastic; moderately alkaline; strongly effervescent throughout (HCl, unspecified).

Range in Characteristics

Mollic epipedon thickness: 7 to 16 inches
Depth to lime: 10 to 32 inches

Ap horizon:
Value: 2 or 3, 3 to 5 dry

Bw horizon:
Hue: 10YR or 2.5Y
Value: 3 to 5, 4 to 6 dry
Chroma: 2 to 4
Texture: silt loam or silty clay loam

Bk horizon:
Hue: 10YR or 2.5Y
Value: 4 to 6, 6 to 8 dry
Chroma: 2 to 4
Texture: silt loam or silty clay loam

C horizon:
Value: 4 to 6, 5 to 7 dry
Chroma: 2 to 4
Texture: silt loam, silty clay loam or very fine sandy loam

Hamar Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Rapid or moderately rapid
Landform: Till plains
Parent material: Eolian
Slope: 0 to 1 percent

Taxonomic class: Sandy, mixed, frigid Typic Endoaquolls

Typical pedon: (Outside Towner County)
Hamar loamy fine sand, 1,190 feet west and 290 feet north of the southeast corner of sec. 6, T. 128 N., R. 58 W.

A1—0 to 7 inches; black (10YR 2/1) loamy fine sand, dark gray (10YR 4/1) dry; single grain; many fine and medium roots; few fine distinct yellowish brown (10YR 5/6) masses of iron accumulation pedogenic throughout; slightly alkaline; clear wavy boundary.

A2—7 to 12 inches; black (10YR 2/1) loamy fine sand, dark gray (10YR 4/1) dry; single grain; many fine and medium roots; common fine distinct dark yellowish brown (10YR 4/4) masses of iron accumulation pedogenic throughout and common fine prominent brown (7.5YR 4/4) masses of iron accumulation pedogenic throughout; slightly alkaline; clear wavy boundary.

AC—12 to 17 inches; very dark gray (10YR 3/1) loamy fine sand, gray (10YR 5/1) dry; single grain; common fine and medium roots; common fine distinct dark yellowish brown (10YR 4/4) masses of iron accumulation pedogenic throughout; moderately alkaline; clear wavy boundary.

C1—17 to 23 inches; very dark grayish brown (10YR 3/2) fine sand, grayish brown (10YR 5/2) dry; single grain; few fine distinct dark yellowish brown (10YR 4/4) masses of iron accumulation pedogenic throughout and few fine prominent yellowish brown (10YR 5/6) masses of iron accumulation pedogenic throughout; slightly alkaline; clear wavy boundary.

C2—23 to 40 inches; grayish brown (2.5Y 5/2) fine sand, light brownish gray (2.5Y 6/2) dry; single grain; common fine and medium roots in upper part and few fine and medium roots in lower part; common fine prominent yellowish brown (10YR 5/6) masses of iron accumulation pedogenic throughout; slightly effervescent in the lower part (HCl, unspecified); slightly alkaline; clear wavy boundary.

Ab—40 to 47 inches; very dark gray (10YR 3/1) loamy fine sand, gray (10YR 5/1) dry; single grain; few fine and medium roots; few fine distinct dark yellowish brown (10YR 4/4) masses of iron accumulation pedogenic throughout; strongly effervescent throughout (HCl, unspecified); moderately alkaline; clear wavy boundary.

Cg—47 to 60 inches; olive gray (5Y 5/2), fine sand, light gray (5Y 7/2) dry; single grain; few fine and medium roots; common fine prominent dark yellowish brown (10YR 4/4) masses of iron accumulation pedogenic throughout and common fine prominent yellowish brown (10YR 5/6) masses of iron accumulation pedogenic throughout and few fine distinct greenish gray (5G 5/1) iron depletions pedogenic throughout; strongly effervescent throughout (HCl, unspecified); moderately alkaline.

Range in Characteristics

Mollic epipedon thickness: 10 to 20 inches
Depth to lime: greater than 30 inches

Ab horizon:
Notes: Some pedons do not have an Ab horizon.

Hamerly Series

Depth class: Very deep
Drainage class: Somewhat poorly drained
Permeability: Moderately slow
Landform: Till plains
Parent material: Glacial till
Slope: 0 to 3 percent
Notes: These soils are highly calcareous.

Taxonomic class: Fine-loamy, mixed, superactive, frigid Aeric Calciaquolls

Typical Pedon
Hamerly loam, in an area of Hamerly-Barnes loams, 0 to 3 percent slopes, 300 feet south and 150 feet west of the northeast corner of sec. 32, T. 160 N., R. 67 W.

Ap—0 to 10 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; weak medium subangular blocky structure parting to moderate medium granular; slightly hard, friable, slightly sticky and slightly plastic; common very fine and few very fine roots; slightly alkaline; slightly effervescent throughout (HCl, unspecified); abrupt smooth boundary.

Bk1—10 to 16 inches; light olive brown (2.5Y 5/3) clay loam, light gray (2.5Y 7/2) dry; moderate medium prismatic structure parting to moderate medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; moderately alkaline; common medium irregular soft masses of lime pedogenic; violently effervescent throughout (HCl, unspecified); gradual wavy boundary.

Bk2—16 to 30 inches; light brownish gray (2.5Y 6/2) clay loam, light gray (2.5Y 7/2) dry; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; moderately alkaline; common medium irregular soft masses of lime pedogenic; violently effervescent throughout (HCl, unspecified); 2 percent mixed gravel; gradual wavy boundary.

C—30 to 60 inches; olive brown (2.5Y 4/3) clay loam, light yellowish brown (2.5Y 6/3) dry; massive; slightly hard, friable, slightly sticky and slightly plastic; moderately alkaline; few fine soft masses of lime pedogenic and few fine prominent olive (5Y 5/6) masses of iron accumulation pedogenic and few fine distinct gray (N 5/0) iron depletions pedogenic; strongly effervescent throughout (HCl, unspecified); 2 percent mixed gravel.

Range in Characteristics

Mollic epipedon thickness: 7 to 16 inches
Salinity: The soil is saline in some map units.
Notes: Some pedons have an ABk horizon.

Ap horizon:
Hue: 10YR or 2.5Y
Value: 2 or 3, 3 or 4 dry

Bk horizon:
Hue: 10YR, 2.5Y or 5Y
Value: 3 to 7, 4 to 8 dry
Chroma: 1 to 4
Texture: loam or clay loam

C horizon:
Hue: 10YR, 2.5Y or 5Y
Value: 4 to 6, 5 to 7 dry
Chroma: 1 to 4
Texture: loam or clay loam

Hecla Series

Depth class: Very deep
Drainage class: Moderately well drained
Permeability: Rapid
Landform: Delta plains
Parent material: Glaciofluvial deposits
Slope: 0 to 3 percent

Taxonomic class: Sandy, mixed Aquic Haploborolls

Typical Pedon
Hecla loamy fine sand, 0 to 3 percent slopes, 700 feet north and 1,500 feet west of the southeast corner of sec. 3, T. 162 N., R. 66 W.

Ap—0 to 9 inches; black (10YR 2/1) loamy fine sand, very dark gray (10YR 3/1) dry; single grain; soft, very friable, nonsticky and nonplastic; many very fine and fine roots; slightly acid; clear smooth boundary.

A1—9 to 15 inches; black (10YR 2/1) loamy fine sand, very dark gray (10YR 3/1) dry; single grain; soft, very friable, nonsticky and nonplastic; few very fine roots; slightly acid; clear smooth boundary.

A2—15 to 24 inches; very dark brown (10YR 2/2) loamy fine sand, dark grayish brown (10YR 4/2) dry; single grain; loose, nonsticky and nonplastic; few very fine roots; slightly acid; clear smooth boundary.

AC—24 to 33 inches; very dark grayish brown (10YR 3/2) loamy fine sand, grayish brown (10YR 5/2) dry; single grain; loose, nonsticky and nonplastic;

neutral; few fine distinct dark yellowish brown (10YR 4/6) masses of iron accumulation pedogenic; gradual wavy boundary.

C1—33 to 43 inches; brown (10YR 5/3) loamy fine sand, pale brown (10YR 6/3) dry; single grain; loose, nonsticky and nonplastic; neutral; common fine and medium distinct grayish brown (2.5Y 5/2) iron depletions pedogenic and few fine distinct dark yellowish brown (10YR 3/6) masses of iron accumulation pedogenic and few fine distinct dark yellowish brown (10YR 4/4) masses of iron accumulation pedogenic and few fine prominent strong brown (7.5YR 4/6) masses of iron accumulation pedogenic; gradual wavy boundary.

C2—43 to 60 inches; yellowish brown (10YR 5/4) loamy fine sand, light yellowish brown (10YR 6/4) dry; single grain; loose, nonsticky and nonplastic; neutral; few fine distinct dark yellowish brown (10YR 3/6) masses of iron accumulation pedogenic and few medium prominent strong brown (7.5YR 4/6) masses of iron accumulation pedogenic.

Range in Characteristics

Depth to lime: 20 to more than 60 inches
Mollic epipedon thickness: 10 to 20 inches

A horizon:
Value: 2 or 3

AC horizon:
Value: 2 or 3, 3 to 5 dry
Chroma: 1 or 2
Texture: loamy fine sand, fine sand or loamy sand

C horizon:
Hue: 10YR, 2.5Y or 5Y
Value: 3 to 5, 4 to 7 dry
Chroma: 2 to 4
Texture: loamy fine sand, loamy sand or fine sand

Hegne Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Very slow
Landform: Lake plains
Parent material: Glaciolacustrine deposits
Slope: 0 to 1 percent
Notes: These soils are highly calcareous.

Taxonomic class: Fine, smectitic, frigid Typic Calciaquerts

Typical Pedon
Hegne silty clay, in an area of Hegne-Fargo silty clays, 2,540 feet north and 2,440 feet east of the southwest corner of sec. 35, T. 157 N., R. 66 W.

Ap—0 to 7 inches; black (N 2/0) silty clay, very dark gray (N 3/0) dry; moderate fine subangular blocky structure; hard, firm, moderately sticky and moderately plastic; few very fine and fine roots; slightly alkaline; few fine prominent dark yellowish brown (10YR 4/6) masses of iron accumulation pedogenic; slightly effervescent throughout (HCl, unspecified); gradual wavy boundary.

ABk—7 to 12 inches; very dark grayish brown (2.5Y 3/2) silty clay, dark grayish brown (2.5Y 4/2) dry; moderate medium subangular blocky structure parting to moderate fine subangular blocky; slightly hard, friable, moderately sticky and moderately plastic; few very fine roots; cracks filled with A horizon material extend throughout; slightly alkaline; common fine distinct light olive brown (2.5Y 5/4) masses of iron accumulation pedogenic; strongly effervescent throughout (HCl, unspecified); gradual smooth boundary.

Bk—12 to 24 inches; grayish brown (2.5Y 5/2) silty clay, light brownish gray (2.5Y 6/2) dry; moderate medium subangular blocky structure parting to moderate fine subangular blocky; slightly hard, friable, moderately sticky and moderately plastic; few very fine roots; moderately alkaline; common fine distinct light olive brown (2.5Y 5/4) masses of iron accumulation pedogenic; violently effervescent throughout (HCl, unspecified); gradual wavy boundary.

Bky—24 to 32 inches; dark grayish brown (2.5Y 4/2) silty clay, light gray (2.5Y 7/2) dry; massive; slightly hard, friable, moderately sticky and moderately plastic; moderately alkaline; few medium nests of gypsum pedogenic and common medium prominent olive yellow (2.5Y 6/6) masses of iron accumulation pedogenic and common medium faint light olive brown (2.5Y 5/3) masses of iron accumulation pedogenic; violently effervescent throughout (HCl, unspecified); clear smooth boundary.

C—32 to 60 inches; olive gray (5Y 5/2) silty clay, light gray (5Y 7/2) dry; massive; slightly hard, friable,

moderately sticky and moderately plastic; moderately alkaline; common medium prominent brownish yellow (10YR 6/8) masses of iron accumulation pedogenic; strongly effervescent throughout (HCl, unspecified).

Range in Characteristics

Mollic epipedon thickness: 7 to 16 inches
Salinity: The soil is saline in some map units.

Ap horizon:
Value: 2 or 3, 3 or 4 dry

Bk horizon:
Chroma: 1 or 2

C horizon:
Hue: 2.5Y or 5Y
Value: 4 to 6, 5 to 7 dry
Chroma: 1 or 2
Texture: silty clay or clay
Notes: It has gypsum in some pedons.

Kensal Series

Depth class: Very deep
Drainage class: Moderately well drained
Permeabiltiy: Moderate over very rapid
Landform: Outwash plains
Parent material: Glaciofluvial deposits
Slope: 0 to 3 percent

Taxonomic class: Fine-loamy over sandy or sandy skeletal, mixed, superactive Aquic Haploborolls

Typical pedon: (Outside Towner County)
Kensal loam, 280 feet west and 50 feet north of the southeast corner of sec. 28. T. 150 N., R. 65 W.

Ap—0 to 8 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; moderate medium granular structure; slightly hard, friable, slightly sticky and slightly plastic; many fine roots throughout; 1 percent mixed gravel; abrupt smooth boundary.

Bw1—8 to 14 inches; very dark grayish brown (10YR 3/2) loam, dark grayish brown (10YR 4/2),dry; moderate medium prismatic structure parting to moderate medium angular blocky; hard, friable, slightly sticky and slightly plastic; common fine roots throughout; common fine pores; very few distinct organic coats on faces of peds; 1 percent mixed gravel; clear wavy boundary.

Bw2—14 to 18 inches; dark grayish brown (2.5Y 4/2) loam, grayish brown (2.5Y 5/2) dry; moderate fine and medium prismatic structure parting to moderate fine and medium angular blocky; hard, friable, slightly sticky and slightly plastic; common fine roots throughout; common fine pores; very few distinct very dark grayish brown (2.5Y 3/2), moist, clay films on faces of peds; common medium yellowish brown (10YR 5/4) soft masses of iron accumulation pedogenic; 3 percent mixed gravel; clear wavy boundary.

Bw3—18 to 24 inches; dark grayish brown (2.5Y 4/2) sandy loam, grayish brown (2.5Y 5/2) dry; weak coarse prismatic structure parting to weak fine and medium subangular blocky; slightly hard, very friable, slightly sticky and slightly plastic; few fine roots throughout; few fine pores; about 85 percent shale in the 0.1 to 76 mm fraction; common fine yellowish brown (10YR 5/4) soft masses of iron accumulation pedogenic; 5 percent mixed gravel; clear wavy boundary.

2C1—24 to 32 inches; dark grayish brown (2.5Y 4/2) loamy sand, light brownish gray (2.5Y 6/2) dry; single grain; loose, slightly sticky and slightly plastic; about 90 percent shale in the 0.1 to 76 mm fraction; slightly effervescent (HCl, unspecified); 1 percent shale-noncalcareous gravel; clear wavy boundary.

2C2—32 to 60 inches; dark grayish brown (2.5Y 4/2) gravelly sand, light brownish gray (2.5Y 6/2) dry; single grain; loose, nonsticky and nonplastic; about 70 percent shale in the 0.1 to 76 mm fraction; strongly effervescent (HCl, unspecified); 40 percent mixed gravel; some crossbedding.

Range in Characteristics

Depth to sand and gravel: 20 to 30 inches

Ap horizon:
Value: 2 or 3, 3 to 5 dry

Bw horizon:
Value: 2 to 4, 3 to 5 dry
Chroma: 2 or 3

2C horizon:
Value: 4 or 5
Notes: It has more than 20 percent shale in the 0.1 to 76 mm fraction. It has 2 to 70 percent gravel.

La Prairie Series

Depth class: Very deep
Drainage class: Moderately well drained
Permeability: Moderate
Landform: Terrace on river valley

Parent material: Alluvium
Slope: 0 to 6 percent

Taxonomic class: Fine-loamy, mixed, superactive Cumulic Udic Haploborolls

Typical pedon: (Outside Towner County)
La Prairie silt loam 2,100 feet west and 1,920 feet north of the southeast corner of sec. 18, T. 137 N., R. 53 W.

Ap—0 to 8 inches; black (10YR 2/1) silt loam, dark gray (10YR 4/1) dry; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many fine roots; many fine pores; noneffervescent; abrupt smooth boundary.

A—8 to 19 inches; black (10YR 2/1) silt loam, dark gray (10YR 4/1) dry; weak coarse prismatic structure parting to weak medium and coarse subangular blocky; hard, friable, slightly sticky and slightly plastic; many fine roots; many fine pores; noneffervescent; clear wavy boundary.

Bw—19 to 28 inches; very dark brown (10YR 2/2) and very dark grayish brown (10YR 3/2) silt loam, dark grayish brown (10YR 4/2) and grayish brown (10YR 5/2) dry; weak coarse prismatic structure parting to weak coarse subangular blocky; hard, friable, slightly sticky and slightly plastic; common fine roots; many fine pores; few masses of lime; slightly effervescent; gradual wavy boundary.

C1—28 to 44 inches; very dark grayish brown (10YR 3/2) and grayish brown (10YR 5/2) silt loam; weak medium and coarse subangular blocky structure; hard, friable, slightly sticky and slightly plastic; few roots; common fine pores; few masses of lime; slightly effervescent; gradual wavy boundary.

C2—44 to 60 inches; brown (10YR 4/3) silt loam, brown (10YR 5/3) dry; weak thin platy structure; hard, friable, slightly sticky and slightly plastic; krotovinas; slightly effervescent.

Range in Characteristics

Mollic epipedon thickness: 16 to greater than 40 inches
Depth to lime: 15 to 40 inches
Notes: Some pedons have a Bk horizon.

A horizon:
Value: 2 or 3, 3 or 4 dry

Bw horizon:
Hue: 10YR or 2.5Y
Value: 2 to 4, 3 to 5 dry
Chroma: 1 to 3
Texture: loam, clay loam or silt loam

C horizon:
Hue: 10YR, 2.5Y or 5Y
Value: 3 to 5, 4 to 7 dry
Chroma: 1 to 4
Texture: loam, clay loam or silt loam

Lallie Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Slow
Landform: Lake plains
Parent material: Glaciolacustrine deposits
Slope: 0 to 1 percent
Notes: These soils are calcareous.

Taxonomic class: Fine, smectitic, calcareous, frigid Vertic Fluvaquents

Typical pedon: (Outside Towner County)
Lallie silty clay loam, 2,630 feet east and 1,300 feet south of the northwest corner of sec. 21, T. 151 N, R. 61 W.

A—0 to 2 inches; black (10YR 2/1), broken face, silty clay loam, dark gray (10YR 4/1), broken face, dry; moderate medium granular and moderate fine granular structure; slightly hard, friable, moderately sticky and moderately plastic; many roots throughout; common fine salt masses pedogenic throughout; strongly effervescent throughout (HCl, unspecified); slightly alkaline; abrupt smooth boundary.

Cg—2 to 24 inches; dark gray (5Y 4/1), broken face, silty clay loam, greenish gray (5G 6/1), broken face, dry; weak coarse prismatic structure parting to moderate fine subangular blocky; slightly hard, friable, moderately sticky and moderately plastic; common fine roots throughout; common medium prominent dark yellowish brown (10YR 4/4) masses of iron accumulation pedogenic throughout and few fine salt masses throughout; violently effervescent throughout (HCl, unspecified); slightly alkaline; abrupt wavy boundary.

Ab—24 to 32 inches; black (N 2/0), broken face, silty clay, very dark gray (5Y 3/1), broken face, dry; weak coarse prismatic structure parting to

moderate medium and fine subangular blocky; hard, firm, very sticky and very plastic; few fine roots throughout; few snail shell fragments; common fine prominent yellowish brown (10YR 5/4) masses of iron accumulation pedogenic throughout and few salt masses pedogenic throughout; strongly effervescent throughout (HCl, unspecified); moderately alkaline; gradual wavy boundary.

Cg'—32 to 60 inches; olive gray (5Y 4/2), silty clay, gray (5Y 6/1) dry; massive; very hard, very firm, very sticky and very plastic; common snail shell fragments; common fine prominent yellowish brown (10YR 5/4) masses of iron accumulations pedogenic throughout and few salt masses pedogenic throughout; strongly effervescent throughout (HCl, unspecified); slightly alkaline.

Range in Characteristics

10 to 40 inch particle-size control section:
averages 35 to 60 percent clay

A horizon:
Texture: silt clay loam, silty clay or clay

Cg horizon:
Notes: It has gypsum in some pedons.

Lamoure Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Moderately slow
Landform: Till plains
Parent material: Alluvium
Slope: 0 to 1 percent
Notes: These soils are calcareous.

Taxonomic class: Fine-silty, mixed, superactive, calcareous, frigid Cumulic Endoaquolls

Typical Pedon:
Lamoure silty clay loam, in an area of Lamoure-Colvin complex, channeled, 150 feet south and 1,450 feet east of the northwest corner of sec. 11, T. 161 N., R. 65 W.

Ag1—0 to 10 inches; black (N 2/0) silty clay loam, very dark gray (N 3/0) dry; weak fine subangular blocky structure parting to weak fine granular; slightly hard, friable, slightly sticky and slightly plastic; many very fine and common fine roots; slightly alkaline; slightly effervescent throughout (HCl, unspecified); clear wavy boundary.

Ag2—10 to 22 inches; black (N 2/0) silt loam, very dark gray (N 3/0) dry; weak fine subangular blocky structure parting to weak fine granular; hard, friable, slightly sticky and slightly plastic; few very fine roots; slightly alkaline; strongly effervescent throughout (HCl, unspecified); gradual wavy boundary.

Ag3—22 to 30 inches; black (N 2/0) silty clay loam, very dark gray (N 3/0) dry; moderate fine subangular blocky structure; hard, friable, slightly sticky and slightly plastic; few very fine roots; moderately alkaline; strongly effervescent throughout (HCl, unspecified); gradual wavy boundary.

Ag4—30 to 42 inches; very dark gray (N 3/0) silty clay loam, dark gray (N 4/0) dry; moderate medium subangular blocky structure; hard, friable, slightly sticky and slightly plastic; few very fine roots; moderately alkaline; strongly effervescent throughout (HCl, unspecified); gradual wavy boundary.

2Cg1—42 to 54 inches; dark gray (5Y 4/1) clay loam, gray (5Y 5/1) dry; moderate medium subangular blocky structure; very hard, firm, moderately sticky and moderately plastic; few snail shells; moderately alkaline; few fine rounded soft masses of lime pedogenic; strongly effervescent throughout (HCl, unspecified); 2 percent mixed gravel; clear wavy boundary.

2Cg2—54 to 60 inches; olive gray (5Y 5/2) clay loam, light olive gray (5Y 6/2) dry; massive; hard, firm, moderately sticky and moderately plastic; moderately alkaline; common fine prominent light olive brown (2.5Y 5/6) masses of iron accumulation pedogenic and few fine prominent gray (10YR 6/1) iron depletions pedogenic and few fine prominent yellowish brown (10YR 5/8) masses of iron accumulation pedogenic; strongly effervescent throughout (HCl, unspecified); 12 percent mixed gravel.

Range in Characteristics

Mollic epipedon thickness: 24 to 42 inches
Depth to lime: 0 to 10 inches
Notes: Some pedons have Ab horizons.

Ag horizon
Value: 3 to 5 dry

2Cg horizon
Hue: 2.5Y or 5Y or neutral
Value: 2 to 6, 4 to 7 dry
Chroma: 0 to 2
Texture: sandy clay loam, clay loam or clay
Notes: Some pedons do not have a 2Cg horizon.

Langhei Series

Depth class: Very deep
Drainage class: Well drained
Permeability: Moderate or moderately slow
Landform: Till plains
Parent material: Glacial till
Slope: 9 to 15 percent
Notes: These soils are highly calcareous.

Taxonomic class: Fine-loamy, mixed, superactive, frigid Typic Eutrochrepts

Typical Pedon: (Outside Towner County)
Langhei loam, 2,250 feet west and 100 feet south of the northeast corner sec. 8, T. 124 N., R. 39 W.

Ap—0 to 6 inches; dark grayish brown (10YR 4/2), broken face, and very dark grayish brown (10YR 3/2), broken face, loam, gray (10YR 6/1), rubbed, dry; weak fine subangular blocky structure; friable; slightly effervescent throughout (HCl, unspecified); 5 percent mixed gravel; moderately alkaline; abrupt smooth boundary.

Bk—6 to 15 inches; grayish brown (2.5Y 5/2), broken face, loam, pale yellow (2.5Y 8/2), broken face, dry; moderate thick platy and weak fine subangular blocky structure; friable; few light gray (2.5Y 7/2) masses of lime pedogenic throughout; strongly effervescent throughout (HCl, unspecified); 5 percent mixed gravel; moderately alkaline; abrupt smooth boundary.

C—15 to 60 inches; light olive brown (2.5Y 5/4) loam; massive; friable; few fine prominent grayish brown (10YR 5/2) masses of iron accumulation pedogenic throughout and few fine distinct yellowish brown (10YR 5/4) masses of iron accumulation pedogenic throughout; 5 percent mixed gravel; slightly effervescent throughout (HCl, unspecified); moderately alkaline.

Range in Characteristics

10 to 40 inch particle-size control section: averages between 18 and 25 percent clay
Percent rock fragments: 2 to 10 percent in the 10 to 40 inch particle-size control section

Ap horizon:
Chroma: 1 or 2 (cultivated); 1 (uncultivated)

Bk and C horizons:
Texture: loam or clay loam

Lanona Series

Depth class: Very deep
Drainage class: Well drained
Permeability: Moderately rapid over moderately slow
Landform: Delta plains and till plains
Parent material: Glaciofluvial deposits over glacial till
Slope: 0 to 6 percent

Taxonomic class: Coarse-loamy, mixed, superactive Udic Haploborolls

Typical pedon: (Outside Towner County)
Lanona fine sandy loam, 150 feet south and 130 feet east of the northwest corner of sec. 4, T. 140 N., R. 57 N.

Ap—0 to 8 inches; black (10YR 2/1) fine sandy loam, very dark gray (10YR 3/1) dry; weak medium granular structure; slightly hard, very friable, slightly sticky and slightly plastic; common very fine and fine roots; many very fine and fine pores; noneffervescent; abrupt smooth boundary.

Bw1—8 to 12 inches; very dark grayish brown (10YR 3/2) fine sandy loam, grayish brown (10YR 5/2) dry; weak coarse prismatic structure parting to weak coarse subangular blocky; slightly hard, very friable, slightly sticky and slightly plastic; many very fine and fine roots; common very fine and fine pores; noneffervescent; clear smooth boundary.

Bw2—12 to 28 inches; dark grayish brown (2.5Y 4/2) fine sandy loam, grayish brown (2.5Y 5/2) dry; weak medium prismatic structure parting to weak medium subangular blocky; slightly hard, very friable, slightly sticky and slightly plastic; many very fine and fine roots; common very fine and fine pores; noneffervescent; gradual wavy boundary.

2Bk—28 to 42 inches; grayish brown (2.5Y 5/2) loam, light brownish gray (2.5Y 6/2) dry; weak fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few very fine and fine roots; few very fine and fine pores;

common masses of lime; violently effervescent; gradual wavy boundary.

2C—42 to 60 inches; light olive brown (2.5Y 5/4) loam, light gray (2.5Y 7/2) dry; few fine distinct gray (10YR 5/1) redoximorphic depletions; massive; slightly hard, friable, slightly sticky and slightly plastic; strongly effervescent. Redoximorphic feature is relict.

Range in Characteristics

Mollic epipedon thickness: 7 to 16 inches
Depth to lime: 14 to 46 inches
Depth to glacial till: 20 to 40 inches

Ap horizon:
Value: 2 or 3, 3 or 4 dry

Bw horizon:
Value: 2 to 5, 4 to 6 dry
Chroma: 1 to 4
Texture: fine sandy loam or sandy loam

2Bk horizon:
Hue: 10YR, 2.5Y or 5Y
Value: 4 to 6, 6 or 7 dry
Chroma: 2 to 4
Texture: loam, clay loam or silt loam

2C horizon:
Hue: 2.5Y or 5Y
Value: 4 to 6, 6 or 7 dry
Chroma: 2 to 4
Texture: loam, clay loam or silt loam

Lindaas Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Slow
Landform: Lake plains
Parent material: Glaciolacustrine deposits
Slope: 0 to 1 percent

Taxonomic class: Fine, smectitic, frigid Typic Argiaquolls

Typical Pedon
Lindaas silt loam, in an area of Bearden-Lindaas silt loams, 2,240 feet north and 75 feet east of the southwest corner of sec. 35, T. 158 N., R. 66 W.

Ap—0 to 6 inches; black (10YR 2/1) silt loam, very dark gray (10YR 3/1) dry; weak medium granular structure parting to weak fine granular; slightly hard, friable, moderately sticky and moderately plastic; many very fine and fine roots; neutral; abrupt wavy boundary.

A—6 to 12 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; moderate medium subangular blocky structure parting to weak fine subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; common very fine and fine roots; neutral; abrupt wavy boundary.

Bt1—12 to 17 inches; black (10YR 2/1) silty clay, dark gray (10YR 4/1) dry; strong medium subangular blocky structure parting to moderate fine subangular blocky; hard, firm, moderately sticky and moderately plastic; common very fine and fine roots; neutral; few faint clay films on faces of peds; clear wavy boundary.

Bt2—17 to 24 inches; very dark grayish brown (2.5Y 3/2) silty clay, grayish brown (2.5Y 5/2) dry; weak medium subangular blocky structure parting to weak fine subangular blocky; hard, firm, moderately sticky and very plastic; few very fine roots; neutral; few faint clay films on faces of peds; clear wavy boundary.

Btg—24 to 29 inches; olive gray (5Y 4/2) silty clay, light olive gray (5Y 6/2) dry; weak medium subangular blocky structure parting to weak fine subangular blocky; hard, firm, very sticky and very plastic; slightly alkaline; few faint clay films on faces of peds; few medium faint dark gray (5Y 4/1) iron depletions pedogenic and few fine prominent yellowish brown (10YR 5/6) masses of iron accumulation pedogenic; clear wavy boundary.

Cg—29 to 60 inches; pale olive (5Y 6/3) silty clay loam, pale yellow (5Y 7/3) dry; massive; hard, firm, moderately sticky and moderately plastic; moderately alkaline; many medium distinct grayish brown (2.5Y 5/2) iron depletions pedogenic and common medium prominent yellowish brown (10YR 5/6) masses of iron accumulation pedogenic; strongly effervescent throughout (HCl, unspecified).

Range in Characteristics

Mollic epipedon thickness: 16 to 35 inches
Depth to lime: 18 to 35 inches
Notes: Some pedons have a Bk horizon.

A horizon:
Hue: 10YR or 2.5Y
Value: 2 or 3, 3 to 5 dry
Chroma: 1 or 2

Bt horizon:
Texture: silty clay or clay

Cg horizon:
Hue: 2.5Y or 5Y
Value: 5 to 7
Chroma: 1 to 4
Texture: silt loam, clay loam or silty clay loam

Maddock Series

Depth class: Very deep
Drainage class: Well drained
Permeability: Rapid
Landform: Delta plains
Parent material: Glaciofluvial deposits
Slope: 1 to 6 percent

Taxonomic class: Sandy, mixed Udorthentic Haploborolls

Typical Pedon
Maddock loamy fine sand, in an area of Maddock-Hecla loamy fine sands, 1 to 6 percent slopes, 2,100 feet west and 1,200 feet south of the northeast corner of sec. 10, T. 159 N., R. 66 W.

Ap—0 to 10 inches; black (10YR 2/1) loamy fine sand, dark gray (10YR 4/1) dry; weak fine granular structure; loose, nonsticky and nonplastic; many very fine and fine and few medium roots; neutral; clear smooth boundary.

Bw—10 to 27 inches; very dark grayish brown (10YR 3/2) loamy fine sand, dark grayish brown (10YR 4/2) dry; weak fine subangular blocky structure parting to weak fine granular; loose, nonsticky and nonplastic; common very fine roots; neutral; clear wavy boundary.

C1—27 to 32 inches; dark yellowish brown (10YR 3/4) fine sand, yellowish brown (10YR 5/4) dry; single grain; loose, nonsticky and nonplastic; few very fine roots; neutral; clear wavy boundary.

C2—32 to 60 inches; dark yellowish brown (10YR 4/4) sand, yellowish brown (10YR 5/4) dry; single grain; loose, nonsticky and nonplastic; neutral.

Range in Characteristics

Ap horizon:
Value: 2 or 3, 3 or 4 dry

Bw horizon:
Value: 3 or 4, 4 or 5 dry
Chroma: 2 to 4
Texture: loamy sand or loamy fine sand
Notes: Some pedons do not have a Bw horizon.

C horizon:
Value: 3 to 6, 5 to 7 dry
Chroma: 2 to 4
Texture: loamy fine sand, loamy sand, fine sand or sand

Marysland Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Moderate over rapid
Landform: Outwash plains
Parent material: Glaciofluvial deposits
Slope: 0 to 1 percent
Notes: These soils are highly calcareous.

Taxonomic class: Fine-loamy over sandy or sandy-skeletal, mixed, superactive, frigid Typic Calciaquolls

Typical Pedon: (Outside Towner County)
Marysland loam, 1,000 feet north and 300 feet east of the southwest corner of sec. 3, T. 159 N., R. 66 W.

Ap—0 to 9 inches; very dark gray (10YR 3/1) loam, gray (10YR 5/1) dry; moderate medium subangular blocky structure parting to weak fine granular; slightly hard, friable, slightly sticky and slightly plastic; many very fine and fine and many medium and coarse roots; moderately alkaline; strongly effervescent throughout (HCl, unspecified); clear wavy boundary.

ABk—9 to 20 inches; very dark gray (10YR 3/1) loam, gray (10YR 5/1) dry; moderate medium subangular blocky structure parting to weak fine subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; common very fine and fine roots; moderately alkaline; common fine and medium soft masses of lime pedogenic and common medium faint dark gray (10YR 4/1) iron depletions pedogenic; violently effervescent throughout (HCl, unspecified); abrupt wavy boundary.

2Cg1—20 to 25 inches; olive gray (5Y 4/2) loamy sand, olive gray (5Y 5/2) dry; single grain; soft, very friable, nonsticky and nonplastic; common very fine roots; slightly alkaline; common fine and medium prominent yellowish brown (10YR 5/6) masses of iron accumulation pedogenic and common fine and medium faint olive (5Y 5/3) masses of iron accumulation pedogenic; slightly effervescent throughout (HCl, unspecified); 10 percent mixed gravel; abrupt wavy boundary.

2Cg2—25 to 48 inches; light brownish gray (2.5Y 6/2) fine sand, light gray (2.5Y 7/2) dry; single grain; loose, nonsticky and nonplastic; slightly alkaline; common medium prominent yellowish brown (10YR 5/6) masses of iron accumulation pedogenic and common fine and medium distinct olive (5Y 5/3) masses of iron accumulation pedogenic and few medium prominent reddish brown (5YR 4/4) masses of iron accumulation pedogenic; slightly effervescent throughout (HCl, unspecified); 5 percent mixed gravel; clear wavy boundary.

2Cg3—48 to 53 inches; olive gray (5Y 4/2) fine sand, light gray (5Y 7/2) dry; single grain; loose, nonsticky and nonplastic; slightly alkaline; common medium distinct grayish brown (2.5Y 5/2) iron depletions pedogenic and common medium distinct olive brown (2.5Y 4/3) masses of iron accumulation pedogenic; strongly effervescent throughout (HCl, unspecified); clear wavy boundary.

2Cg4—53 to 60 inches; dark olive brown (2.5Y 3/3) very gravelly sand, olive brown (2.5Y 4/3) dry; single grain; loose, nonsticky and nonplastic; slightly alkaline; few fine prominent reddish brown (5YR 4/4) masses of iron accumulation pedogenic; slightly effervescent throughout (HCl, unspecified); 40 percent mixed gravel.

Range in Characteristics

Mollic epipedon thickness: 7 to 25 inches
Depth to sand and gravel: 20 to 40 inches
Notes: Some pedons have a Bk horizon. Some pedons have an Ab horizon.

Ap horizon:
Value: 2 or 3, 3 to 5 dry

ABk horizon:
Hue: 10YR, 2.5Y or 5Y
Value: 3 to 6, 5 to 7 dry
Chroma: 1 or 2
Notes: Some pedons do not have an ABk horizon.

2Cg horizon:
Texture: coarse sand, sand, loamy sand or fine sand
Notes: It has up to 40 percent gravel. In some pedons the sand and gravel is dominantly shale.

Overly Series

Depth class: Very deep
Drainage class: Moderately well drained
Permeability: Moderately slow
Landform: Lake plains
Parent material: Glaciolacustrine deposits
Slope: 0 to 3 percent

Taxonomic class: Fine-silty, mixed, superactive Pachic Udic Haploborolls

Typical Pedon
Overly silt loam, in an area of Great Bend-Overly silt loams, 0 to 3 percent slopes, 100 feet south and 90 feet east of the northwest corner of sec. 31, T. 158 N., R. 65 W.

Ap—0 to 8 inches; black (10YR 2/1) silt loam, very dark gray (10YR 3/1) dry; weak medium subangular blocky structure parting to weak medium granular; slightly hard, friable, slightly sticky and slightly plastic; few very fine and fine roots; neutral; abrupt smooth boundary.

A—8 to 16 inches; black (10YR 2/1) silt loam, very dark gray (10YR 3/1) dry; weak medium prismatic structure parting to weak medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; neutral; clear wavy boundary.

Bw—16 to 25 inches; dark brown (10YR 3/3) silt loam, brown (10YR 5/3) dry; weak medium prismatic structure parting to moderate medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; tongues of A horizon material extend throughout; neutral; clear wavy boundary.

Bk—25 to 33 inches; light yellowish brown (2.5Y 6/3) silt loam, pale yellow (2.5Y 7/3) dry; moderate medium subangular blocky structure parting to weak medium subangular blocky; hard, friable, slightly sticky and slightly plastic; moderately alkaline; strongly effervescent throughout (HCl, unspecified); clear wavy boundary.

C1—33 to 48 inches; light olive brown (2.5Y 5/3) silt loam, light yellowish brown (2.5Y 6/3) dry; massive; hard, friable, slightly sticky and slightly plastic; moderately alkaline; few fine prominent gray (10YR 5/1) iron depletions pedogenic; strongly effervescent throughout (HCl, unspecified); gradual wavy boundary.

C2—48 to 60 inches; light olive brown (2.5Y 5/3) and olive brown (2.5Y 4/3) stratified silt loam, pale yellow (2.5Y 7/3) and light olive brown (2.5Y 5/3) dry; massive; slightly hard, friable, slightly sticky and slightly plastic; common krotovina; moderately alkaline; common medium distinct light brownish gray (10YR 6/2) iron depletions pedogenic; strongly effervescent throughout (HCl, unspecified).

Range in Characteristics

Mollic epipedon thickness: 16 to 34 inches

A horizon:
Value: 2 or 3, 3 or 4 dry

Bw horizon:
Hue: 10YR or 2.5Y
Value: 2 to 4, 3 to 5 dry
Chroma: 1 to 4

Bk horizon:
Hue: 10YR or 2.5Y
Value: 3 to 6, 4 to 7 dry
Chroma: 1 to 4

C horizon:
Value: 4 to 6
Chroma: 2 to 4
Texture: silt loam or silty clay loam

Parnell Series

Depth class: Very deep
Drainage class: Very poorly drained
Permeability: Slow
Landform: Till plains
Parent material: Alluvium
Slope: 0 to 1 percent

Taxonomic class: Fine, smectitic, frigid Vertic Argiaquolls

Typical Pedon
Parnell silt loam, in an area of Hamerly-Tonka-Parnell complex, 0 to 3 percent slopes, 2,300 feet south and 1,000 feet west of the northeast corner of sec. 26, T. 160 N., R. 67 W.

Oi—0 to 2 inches; undecomposed litter of leaves, twigs and roots.

A—2 to 5 inches; black (10YR 2/1) silt loam, very dark gray (10YR 3/1) dry; moderate very fine granular structure; slightly hard, very friable, slightly sticky and slightly plastic; many very fine, fine and medium roots; slightly acid; abrupt smooth boundary.

Ag—5 to 27 inches; black (N 2/0) silty clay loam, very dark gray (N 3/0) dry; weak medium subangular blocky structure; hard, firm, slightly sticky and slightly plastic; few very fine and fine roots; slightly acid; clear wavy boundary.

Btg1—27 to 37 inches; black (5Y 2/1) silty clay, very dark gray (5Y 3/1) dry; weak fine prismatic structure parting to weak very fine subangular blocky; hard, firm, moderately sticky and moderately plastic; few very fine and fine roots; few uncoated sand grains on faces of peds; neutral; common faint clay films on faces of peds; gradual wavy boundary.

Btg2—37 to 45 inches; very dark gray (5Y 3/1) silty clay, dark gray (5Y 4/1) dry; weak fine subangular blocky structure; hard, firm, moderately sticky and moderately plastic; few very fine and fine roots; few uncoated sand grains on faces of peds; slight effervescence in the lower part; slightly alkaline; common faint clay films on faces of peds; clear wavy boundary.

Cg1—45 to 52 inches; dark gray (5Y 4/1) silty clay loam, gray (5Y 6/1) dry; massive; hard, firm, slightly sticky and slightly plastic; few very fine and fine roots; tongues of Bt material extend into upper part; slightly alkaline; few fine distinct olive (5Y 5/3) masses of iron accumulation pedogenic; strongly effervescent throughout (HCl, unspecified); 2 percent mixed gravel; gradual wavy boundary.

Cg2—52 to 60 inches; olive gray (5Y 5/2) silty clay loam, light gray (5Y 7/2) dry; massive; hard, firm, slightly sticky and slightly plastic; slightly alkaline; few fine prominent dark yellowish brown (10YR 4/4) masses of iron accumulation pedogenic and few fine prominent olive brown (2.5Y 4/4) masses of iron accumulation pedogenic and common fine prominent yellowish red (5YR 5/6) masses of iron accumulation pedogenic; violently effervescent throughout (HCl, unspecified); 2 percent mixed gravel.

Range in Characteristics

Mollic epipedon thickness: 30 to 60 inches
Notes: Some pedons have an E horizon up to 4 inches thick.

A horizon:
Value: 2 or 3, 3 or 4 dry

Btg horizon:
Chroma: 1 or 2
Texture: silty clay loam, silty clay or clay loam

Cg horizon:
Hue: 2.5Y or 5Y
Value: 3 to 6, 4 to 7 dry
Texture: silty clay loam or clay loam

Perella Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Moderate or moderately slow
Landform: Lake plains
Parent material: Glaciolacustrine deposits
Slope: 0 to 1 percent

Taxonomic class: Fine-silty, mixed, superactive, frigid Typic Epiaquolls

Typical pedon: (Outside Towner County) Perella silty clay loam,1,390 feet north and 300 feet west of the southeast corner of sec. 31, T. 162 N., R. 51 W.

A1—0 to 9 inches; black (N 2/0), broken face, silty clay loam, very dark gray (N 3/0), broken face, dry; moderate very fine angular blocky structure; very hard, very friable, moderately sticky and slightly plastic; many roots throughout; many pores; neutral; clear irregular boundary.

A2—9 to 14 inches; very dark gray (5Y 3/1), broken face, silty clay loam, dark gray (5Y 4/1), broken face, dry; moderate very fine angular blocky structure; very hard, very friable, moderately sticky and slightly plastic; many roots throughout; many pores; few fine prominent light olive brown (2.5Y 5/6) masses of iron accumulation pedogenic throughout; neutral; clear wavy boundary.

Bg1—14 to 18 inches; very dark gray (5Y 3/1), broken face, silty clay loam, gray (5Y 5/1), broken face, dry; strong fine and very fine angular blocky structure; hard, friable, moderately sticky and moderately plastic; common roots throughout; many fine pores; many fine prominent dark yellowish brown (10YR 4/4) masses of iron accumulation pedogenic throughout and many fine distinct olive (5Y 4/3) masses of iron accumulation pedogenic throughout; neutral; gradual wavy boundary.

Bg2—18 to 24 inches; dark gray (5Y 4/1), broken face, silty clay loam, gray (5Y 5/1), broken face, dry; moderate medium platy and moderate thin platy structure; hard, friable, moderately sticky and moderately plastic; few roots throughout; many fine pores; many fine prominent dark brown (10YR 3/3) masses of iron accumulation pedogenic throughout and many fine distinct olive (5Y 5/4) masses of iron accumulation pedogenic throughout; slightly alkaline; clear wavy boundary.

Cg1—24 to 30 inches; olive gray (5Y 5/2) silt loam, light gray (5Y 7/2) dry; massive; hard, friable, slightly sticky and slightly plastic; few roots throughout; common fine pores; many fine prominent strong brown (7.5YR 5/6) masses of iron accumulation pedogenic throughout and many fine prominent dark reddish brown (5YR 3/4) masses of iron accumulation pedogenic throughout and many coarse prominent dark reddish brown (5YR 2/2) masses of iron accumulation pedogenic throughout; slightly alkaline; gradual wavy boundary.

Cg2—30 to 52 inches; gray (5Y 6/1) silt loam, light gray (5Y 7/1) dry; massive; hard, friable, slightly sticky and slightly plastic; few medium pores; many fine prominent strong brown (7.5YR 5/6) masses of iron accumulation pedogenic throughout and many fine masses of iron-manganese accumulation pedogenic throughout; slightly effervescent throughout (HCl, unspecified); moderately alkaline; gradual wavy boundary.

Cg3—52 to 60 inches; light olive brown (2.5Y 5/4) silty clay loam, pale yellow (2.5Y 7/4) dry; massive; hard, friable, moderately sticky and moderately plastic; many medium prominent gray (5Y 6/1) iron depletions pedogenic throughout and many fine prominent strong brown (7.5YR 5/6) masses of iron accumulation pedogenic throughout and few fine soft masses of iron accumulation pedogenic; slightly effervescent throughout (HCl, unspecified); moderately alkaline.

Range in Characteristics

Mollic epipedon thickness: 10 to 24 inches
Depth to lime: 16 to 36 inches

Renshaw Series

Depth class: Very deep
Drainage class: Somewhat excessively drained
Permeability: Very rapid

Landform: Outwash plains and till plains
Parent material: Glacial outwash
Slope: 0 to 6 percent

Taxonomic class: Fine-loamy over sandy or sandy-skeletal, mixed, superactive Udic Haploborolls

Typical pedon: (Outside Towner County)
Renshaw loam, 80 feet north and 225 feet east of the southwest corner of sec. 5, T. 117 N., R. 53 W.

Ap—0 to 7 inches; black (10YR 2/1), broken face, loam, dark gray (10YR 4/1), broken face, dry; weak fine granular structure; slightly hard, very friable; neutral; clear smooth boundary.

Bw—7 to 15 inches; very dark grayish brown (10YR 3/2), broken face, loam, dark grayish brown (10YR 4/2), broken face, dry; weak medium prismatic structure parting to weak medium subangular blocky; slightly hard, very friable; few pebbles; neutral; abrupt wavy boundary.

2Bk—15 to 20 inches; vari-colored gravelly loamy sand; single grain; loose; masses of lime on undersides of pebbles; slightly effervescent throughout (HCl, unspecified); slightly alkaline; diffuse wavy boundary.

2C—20 to 60 inches; vari-colored gravelly loamy sand; single grain; loose; strongly effervescent throughout (HCl, unspecified); slightly alkaline.

Range in Characteristics

Mollic epipedon thickness: 7 to 16 inches
Depth to sand and gravel: 14 to 20 inches
Notes: Some pedons have Bk horizons.

Bw horizon:
Notes: It has less than 30 percent gravel.

2Bk and 2C horizons:
Texture: loamy sand, sand or coarse sand
Notes: It has 15 to 55 percent gravel.

Sioux Series

Depth class: Very deep
Drainage class: Excessively drained
Permeability: Excessive
Landform: Outwash plains and till plains
Parent material: Glaciofluvial deposits
Slope: 0 to 15 percent

Taxonomic class: Sandy-skeletal, mixed Udorthentic Haploborolls

Typical pedon: (Outside Towner County)
Sioux loam, 1,200 feet west and 2,375 feet south of the northeast corner of sec. 33, T. 126 N., R. 53 W.

A—0 to 5 inches; black (10YR 2/1), broken face, loam, dark gray (10YR 4/1), broken face, dry; weak fine and medium granular structure; soft, very friable; many fine roots throughout; slightly alkaline; clear smooth boundary.

AC—5 to 8 inches; very dark grayish brown (10YR 3/2), broken face, gravelly loam, grayish brown (10YR 5/2), broken face, dry; weak coarse subangular blocky structure; soft, very friable; common fine roots throughout; slightly effervescent throughout (HCl, unspecified); moderately alkaline; clear smooth boundary.

C—8 to 60 inches; brown (10YR 5/3) and dark yellowish brown (10YR 4/4) very gravelly sand, light brownish gray (10YR 6/2) and pale brown (10YR 6/3) dry; single grain; loose; masses of lime on undersides of pebbles in the upper part; slightly effervescent throughout (HCl, unspecified); moderately alkaline.

Range in Characteristics

Mollic epipedon thickness: 7 to 14 inches
Depth to lime: 3 to 10 inches
10 to 40 inch particle-size control section: has more than 35 percent gravel
Depth to sand and gravel: 6 to 14 inches
Notes: Some pedons have a Bk horizon.

Southam Series

Depth class: Very deep
Drainage class: Very poorly drained
Permeability: Slow
Landform: Till plains
Parent material: Alluvium
Slope: 0 to 1 percent
Notes: These soils are calcareous.

Taxonomic class: Fine, smectitic, calcareous, frigid Cumulic Vertic Endoaquolls

Typical Pedon
Southam silty clay loam, 1,000 feet north and 200 feet west of the southeast corner of sec. 7, T. 158 N., R. 66 W.

Ag1—0 to 5 inches; black (5Y 2/1) silty clay loam, dark gray (5Y 4/1) dry; weak fine subangular blocky structure; slightly hard, firm, moderately sticky and moderately plastic; common very fine

and few medium roots; few fine snail shell fragments; slightly alkaline; strongly effervescent throughout (HCl, unspecified); gradual wavy boundary.

Ag2—5 to 26 inches; black (5Y 2/1) silty clay loam, dark gray (5Y 4/1) dry; weak medium subangular blocky structure; very hard, firm, very sticky and very plastic; few very fine roots; few fine snail shell fragments; slightly alkaline; few fine distinct olive gray (5Y 4/2) iron depletions pedogenic; strongly effervescent throughout (HCl, unspecified); gradual wavy boundary.

Ag3—26 to 31 inches; very dark gray (5Y 3/1) silty clay loam, gray (5Y 5/1) dry; weak medium subangular blocky structure; hard, very firm, very sticky and very plastic; few fine snail shell fragments; moderately alkaline; few fine nests of gypsum pedogenic and few fine distinct olive gray (5Y 4/2) iron depletions pedogenic; violently effervescent throughout (HCl, unspecified); gradual wavy boundary.

Cg1—31 to 37 inches; olive gray (5Y 4/2) silty clay loam, gray (5Y 6/1) dry; massive; very hard, very firm, very sticky and very plastic; few fine snail shell fragments; slightly alkaline; few fine distinct olive (5Y 5/4) masses of iron accumulation pedogenic; strongly effervescent throughout (HCl, unspecified); gradual wavy boundary.

Cg2—37 to 60 inches; very dark gray (5Y 3/1) silty clay loam, gray (5Y 5/1) dry; massive; very hard, very firm, moderately sticky and moderately plastic; few fine snail shell fragments; slightly alkaline; few fine soft masses of lime pedogenic and few fine iron-manganese concretions pedogenic and few medium distinct olive (5Y 5/4) masses of iron accumulation pedogenic; strongly effervescent throughout (HCl, unspecified).

Range in Characteristics

Mollic epipedon thickness: 24 to 60 inches
Notes: Some pedons have an O horizon up to 5 inches thick. Some pedons have a 2C horizon.

Ag horizon
Hue: 10YR, 5Y or neutral
Chroma: 0 or 1

Cg horizon
Hue: 2.5Y or 5Y
Value: 5 to 7 dry
Texture: silty clay loam, clay loam, silty clay or clay

Svea Series

Depth class: Very deep
Drainage class: Well and moderately well drained
Permeability: Moderately slow
Landform: Till plains
Parent material: Glacial till
Slope: 0 to 25 percent

Taxonomic class: Fine-loamy, mixed, superactive Pachic Udic Haploborolls

Typical Pedon
Svea loam, in an area of Barnes-Svea loams, 0 to 3 percent slopes, 400 feet south and 1,800 feet west of the northeast corner of sec. 29, T. 159 N., R. 68 W.

Ap—0 to 10 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak medium granular structure parting to weak fine granular; soft, very friable, slightly sticky and slightly plastic; few very fine and fine roots; neutral; clear smooth boundary.

A—10 to 15 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; moderate medium prismatic structure parting to moderate medium subangular blocky; soft, very friable, slightly sticky and slightly plastic; few very fine and fine roots; neutral; clear smooth boundary.

Bw—15 to 21 inches; very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; weak coarse prismatic structure parting to moderate medium subangular blocky; slightly hard, very friable, slightly sticky and slightly plastic; few very fine and fine roots; slightly alkaline; 1 percent mixed gravel; abrupt smooth boundary.

Bk—21 to 33 inches; olive brown (2.5Y 4/4) loam, light olive brown (2.5Y 5/4) dry; moderate medium subangular blocky structure parting to moderate fine subangular blocky; slightly hard, friable, moderately sticky and slightly plastic; moderately alkaline; few medium soft masses of lime pedogenic and few fine prominent dark grayish brown (10YR 4/2) iron depletions pedogenic; strongly effervescent throughout (HCl, unspecified); 3 percent mixed gravel; gradual wavy boundary.

C—33 to 60 inches; light olive brown (2.5Y 5/4) clay loam, light yellowish brown (2.5Y 6/4) dry; massive; slightly hard, friable, moderately sticky and slightly plastic; slightly alkaline; common fine

soft masses of lime pedogenic and few fine prominent light reddish brown (5YR 6/4) masses of iron accumulation pedogenic and common fine prominent dark grayish brown (10YR 4/2) iron depletions pedogenic; strongly effervescent throughout (HCl, unspecified); 5 percent mixed gravel.

Range in Characteristics

Mollic epipedon thickness: 16 to 30 inches

A horizon:
Value: 2 or 3, 3 to 5 dry

Bw horizon:
Hue: 10YR or 2.5Y
Value: 2 to 4, 4 or 5 dry
Chroma: 1 to 3
Texture: loam or clay loam

Bk horizon:
Value: 4 to 6, 5 to 8 dry
Chroma: 2 to 4
Texture: loam or clay loam

Swenoda Series

Depth class: Very deep
Drainage class: Moderately well drained
Permeability: Moderately rapid over moderately slow
Landform: Delta plains and till plains
Parent material: Glaciofluvial deposits over glacial till
Slope: 0 to 6 percent

Taxonomic class: Coarse-loamy, mixed, superactive Pachic Udic Haploborolls

Typical Pedon
Swenoda fine sandy loam, 0 to 6 percent slopes, 100 feet north and 2,300 feet east of the southwest corner of sec. 32, T. 159 N., R. 65 W.

Ap—0 to 10 inches; black (10YR 2/1) fine sandy loam, very dark grayish brown (10YR 3/2) dry; weak coarse subangular blocky structure parting to weak fine subangular blocky; soft, very friable, slightly sticky and nonplastic; few very fine and fine roots; neutral; gradual wavy boundary.

A—10 to 17 inches; black (10YR 2/1) fine sandy loam, very dark grayish brown (10YR 3/2) dry; weak thick platy structure parting to weak thin platy; soft, very friable, slightly sticky and nonplastic; few very fine roots; neutral; gradual wavy boundary.

Bw—17 to 21 inches; dark brown (10YR 3/3) sandy loam, brown (10YR 5/3) dry; weak coarse prismatic structure parting to weak fine subangular blocky; soft, very friable, nonsticky and nonplastic; few very fine roots; neutral; clear smooth boundary.

Bk1—21 to 28 inches; olive brown (2.5Y 4/3) fine sandy loam, light yellowish brown (2.5Y 6/3) dry; weak coarse prismatic structure parting to weak fine subangular blocky; soft, very friable, nonsticky and nonplastic; few very fine roots; slightly alkaline; strongly effervescent throughout (HCl, unspecified); gradual wavy boundary.

Bk2—28 to 34 inches; light olive brown (2.5Y 5/3) fine sandy loam, pale yellow (2.5Y 7/3) dry; weak medium prismatic structure parting to weak medium subangular blocky; soft, very friable, nonsticky and nonplastic; few very fine roots; moderately alkaline; strongly effervescent throughout (HCl, unspecified); gradual wavy boundary.

2C1—34 to 39 inches; light olive brown (2.5Y 5/4) silt loam, light yellowish brown (2.5Y 6/4) dry; massive; slightly hard, friable, slightly sticky and slightly plastic; moderately alkaline; strongly effervescent throughout (HCl, unspecified); gradual wavy boundary.

3C2—39 to 60 inches; light olive brown (2.5Y 5/3) clay loam, light yellowish brown (2.5Y 6/3) dry; massive; slightly hard, friable, moderately sticky and slightly plastic; moderately alkaline; few fine nests of gypsum pedogenic and few fine prominent gray (10YR 6/1) iron depletions pedogenic; strongly effervescent throughout (HCl, unspecified); 3 percent mixed gravel.

Range in Characteristics

Mollic epipedon thickness: 16 to 30 inches
Depth to lime: 20 to 40 inches
Depth to glacial till: 20 to 40 inches
Notes: Some pedons have a 2Bk horizon.

A horizon:
Value: 2 to 4, 3 or 4 dry
Chroma: 1 or 2

Bw horizon:
Texture: fine sandy loam, sandy loam or loamy fine sand

Bk horizon:
Hue: 2.5Y or 5Y
Value: 4 to 6, 6 to 8 dry

Chroma: 2 to 6
Texture: sandy loam or fine sandy loam

2C and 3C horizons:
Hue: 10YR or 2.5Y
Value: 4 to 6, 6 to 8 dry
Chroma: 2 to 6
Texture: loam, silt loam, clay loam or silty clay loam
Notes: A stone line is at the upper boundary of the 2C horizon in some pedons.

Tiffany Series

Depth class: Very deep
Drainage class: Somewhat poorly drained
Permeability: Moderately rapid over moderately slow
Landform: Lake plains
Parent material: Glaciolacustrine deposits
Slope: 0 to 1 percent

Taxonomic class: Coarse-loamy, mixed, superactive, frigid Typic Endoaquolls

Typical Pedon
Tiffany loam, in an area of Wyndmere-Tiffany loams, silty substratum, 580 feet south and 2,380 feet west of the northeast corner of sec. 5, T. 157 N., R. 65 W.

Ap—0 to 10 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak fine and medium subangular blocky structure parting to weak fine granular; slightly hard, very friable, slightly sticky and slightly plastic; many very fine and fine, few medium and common coarse roots; neutral; abrupt wavy boundary.

A—10 to 23 inches; black (10YR 2/1) fine sandy loam, dark gray (10YR 4/1) dry; weak medium subangular blocky structure parting to weak fine granular; slightly hard, very friable, slightly sticky and slightly plastic; many very fine and fine and few medium and coarse roots; neutral; clear wavy boundary.

AC—23 to 37 inches; dark grayish brown (2.5Y 4/2) fine sandy loam, light brownish gray (2.5Y 6/2) dry; weak coarse subangular blocky structure parting to weak thick platy; slightly hard, very friable, slightly sticky and nonplastic; common very fine and fine roots; 1/2 inch wide tongues of A horizon material extend into upper 12 inches; slightly alkaline; few fine prominent yellowish brown (10YR 5/6) masses of iron accumulation pedogenic; clear wavy boundary.

C1—37 to 51 inches; grayish brown (2.5Y 5/2) fine sandy loam, light gray (2.5Y 7/2) dry; massive; soft, very friable, nonsticky and nonplastic; slightly alkaline; few fine soft masses of iron-manganese accumulation pedogenic and many medium and coarse prominent yellowish brown (10YR 5/6) masses of iron accumulation pedogenic; strongly effervescent throughout (HCl, unspecified); abrupt wavy boundary.

2C2—51 to 60 inches; yellowish brown (10YR 5/6) stratified very fine sandy loam and silty clay loam, brownish yellow (10YR 6/6) dry; massive; hard, firm, slightly sticky and slightly plastic; slightly alkaline; few fine soft masses of iron-manganese accumulation pedogenic and common fine nests of gypsum pedogenic and common fine prominent yellowish red (5YR 5/6) masses of iron accumulation pedogenic and many medium and coarse prominent grayish brown (2.5Y 5/2) iron depletions pedogenic; strongly effervescent throughout (HCl, unspecified).

Range in Characteristics

Mollic epipedon thickness: 10 to 24 inches
Depth to silty substratum: 40 to 60 inches
Notes: Some pedons have a Bw horizon.

A horizon:
Value: 2 or 3, 3 to 5 dry
Chroma: 1 or 2

C horizon:
Texture: loamy fine sand, fine sandy loam or very fine sandy loam

2C horizon:
Texture: very fine sandy loam, silt loam or silty clay loam

Tonka Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Slow
Landform: Till plains
Parent material: Alluvium over glacial till
Slope: 0 to 1 percent

Taxonomic class: Fine, smectitic, frigid Argiaquic Argialbolls

Typical Pedon
Tonka silt loam, in an area of Hamerly-Tonka-Parnell complex, 0 to 3 percent slopes, 2,200 feet north and

400 feet west of the southeast corner of sec. 33, T. 161 N., R. 68 W.

Ap—0 to 8 inches; black (10YR 2/1) silt loam, very dark gray (10YR 3/1) dry; moderate medium subangular blocky structure; slightly hard, very friable, moderately sticky and slightly plastic; common very fine and fine roots; neutral; clear smooth boundary.

A—8 to 12 inches; black (10YR 2/1) silt loam, very dark gray (10YR 3/1) dry; moderate medium subangular blocky structure parting to weak fine subangular blocky; hard, friable, moderately sticky and slightly plastic; common very fine roots; neutral; clear smooth boundary.

E—12 to 18 inches; very dark gray (10YR 3/1) silt loam, gray (10YR 5/1) dry; moderate thin platy structure; hard, friable, moderately sticky and slightly plastic; common very fine roots; neutral; common fine prominent yellowish red (5YR 4/6) masses of iron accumulation pedogenic; clear smooth boundary.

Bt1—18 to 35 inches; very dark grayish brown (10YR 3/2) silty clay, dark grayish brown (10YR 4/2) dry; strong fine subangular blocky structure; very hard, very firm, very sticky and moderately plastic; common very fine roots; neutral; distinct continuous clay films on faces of peds; common fine prominent yellowish red (5YR 4/6) masses of iron accumulation pedogenic; gradual wavy boundary.

Bt2—35 to 42 inches; dark grayish brown (2.5Y 4/2) silty clay, grayish brown (2.5Y 5/2) dry; strong medium subangular blocky structure; very hard, very firm, very sticky and moderately plastic; few very fine roots; slightly alkaline; many distinct clay films on faces of peds; common medium prominent yellowish red (5YR 4/6) masses of iron accumulation pedogenic; gradual wavy boundary.

Bk—42 to 50 inches; grayish brown (2.5Y 5/2) silty clay loam, light brownish gray (2.5Y 6/2) dry; moderate medium subangular blocky structure; hard, firm, moderately sticky and moderately plastic; few very fine roots; slightly alkaline; many fine soft masses of lime pedogenic and common medium prominent yellowish red (5YR 4/6) masses of iron accumulation pedogenic; violently effervescent throughout (HCl, unspecified); diffuse wavy boundary.

2C—50 to 60 inches; grayish brown (2.5Y 5/2) clay loam, light brownish gray (2.5Y 6/2) dry; massive; hard, firm, moderately sticky and moderately plastic; slightly alkaline; many fine soft masses of lime pedogenic and many medium prominent yellowish red (5YR 4/6) masses of iron accumulation pedogenic; strongly effervescent throughout (HCl, unspecified).

Range in Characteristics

A horizon:
Value: 3 or 4 dry

E horizon:
Value: 5 to 7 dry
Chroma: 1 or 2
Texture: loam, silt loam or silty clay loam

Bt horizon:
Value: 4 to 6 dry
Chroma: 1 or 2
Texture: silty clay, silty clay loam or clay loam

2C horizon:
Hue: 10YR, 2.5Y or 5Y
Value: 5 or 6, 5 to 8 dry
Chroma: 2 to 4
Texture: silty clay, clay loam or silty clay loam

Towner Series

Depth class: Very deep
Drainage class: Well drained
Permeability: Rapid or moderately rapid over moderate or moderately slow
Landform: Lake plains and till plains
Parent material: Eolian over glacial till
Slope: 0 to 6 percent

Taxonomic class: Sandy over loamy, mixed, superactive Udorthentic Haploborolls

Typical pedon: (Outside Towner County) Towner loamy fine sand, 552 feet west and 530 feet south of the northeast corner of sec. 5, T. 153 N., R. 74 W.

A1—0 to 6 inches; black (10YR 2/1), broken face, loamy fine sand, dark gray (10YR 4/1), broken face, dry; weak fine granular structure; soft, very friable, nonsticky and nonplastic; many fine roots throughout; neutral; clear wavy boundary.

A2—6 to 20 inches; black (10YR 2/1), broken face, loamy fine sand, dark gray (10YR 4/1), broken face, dry; weak very coarse prismatic structure

parting to weak medium subangular blocky and weak coarse subangular blocky; soft, very friable, nonsticky and nonplastic; common fine roots throughout; slightly alkaline; clear wavy boundary.

Bw—20 to 29 inches; very dark grayish brown (10YR 3/2), broken face, loamy fine sand, grayish brown (10YR 5/2), broken face, dry; weak medium and coarse subangular blocky structure; soft, very friable, nonsticky and nonplastic; common fine roots throughout; slightly alkaline; abrupt wavy boundary.

2Bk—29 to 36 inches; grayish brown (2.5Y 5/2), broken face, loam, light gray (2.5Y 7/2), broken face, dry; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; violently effervescent throughout (HCl, unspecified); moderately alkaline; gradual wavy boundary.

2C—36 to 60 inches; olive brown (2.5Y 4/4), broken face, loam, light brownish gray (2.5Y 6/2), broken face, dry; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; strongly effervescent throughout (HCl, unspecified); moderately alkaline.

Range in Characteristics

Mollic epipedon thickness: 16 to 30 inches
Depth to the glacial till: 20 to 40 inches

2Bk and 2C horizons:
Texture: loam or clay loam

Ulen Series

Depth class: Very deep
Drainage class: Somewhat poorly drained
Permeability: Rapid
Landform: Lake plains
Parent material: Glaciolacustrine deposits
Slope: 0 to 3 percent
Notes: These soils are highly calcareous.

Taxonomic class: Fine, sandy, mixed, frigid Aeric Calciaquolls

Typical pedon: (Outside Towner County) Ulen loamy fine sand, 270 feet north and 320 feet west of the southeast corner of sec. 19, T. 144 N., R. 44 W.

Ap—0 to 10 inches; black (10YR 2/1), broken face, loamy fine sand, dark gray (10YR 4/1), broken face, dry; weak medium subangular blocky structure; very friable; strongly effervescent throughout (HCl, unspecified); moderately alkaline; abrupt smooth boundary.

Ak—10 to 15 inches; very dark gray (10YR 3/1), broken face, very fine sandy loam, gray (10YR 5/1), broken face, dry; weak fine and medium subangular blocky structure; very friable; violently effervescent throughout (HCl, unspecified); moderately alkaline; clear wavy boundary.

Bk—15 to 20 inches; dark grayish brown (10YR 4/2), broken face, loamy fine sand; weak fine and medium subangular blocky structure; very friable; few fine faint grayish brown (10YR 5/2) masses of iron accumulation pedogenic throughout; violently effervescent throughout (HCl, unspecified); moderately alkaline; clear smooth boundary.

C1—20 to 26 inches; brownish yellow (10YR 6/6), broken face, loamy fine sand; weak medium subangular blocky structure; very friable; about 5 percent root channel fillings of dark grayish brown 2.5Y 4/2; strongly effervescent throughout (HCl, unspecified); moderately alkaline; clear smooth boundary.

C2—26 to 32 inches; light brownish gray (2.5Y 6/2), broken face, loamy fine sand; weak medium subangular blocky structure; very friable; slightly effervescent throughout (HCl, unspecified); moderately alkaline; clear smooth boundary.

C3—32 to 60 inches; light brownish gray (2.5Y 6/2) fine sand; single grain; loose; many medium distinct olive yellow (2.5Y 6/6) masses of iron accumulation pedogenic throughout and few medium prominent dark reddish brown (5YR 3/4) masses of iron accumulation pedogenic throughout and common fine distinct pale yellow (2.5Y 7/4) masses of iron accumulation pedogenic at top of horizon; slightly effervescent throughout (HCl, unspecified); moderately alkaline.

Range in Characteristics

Mollic epipedon thickness: 7 to 20 inches

Vallers Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Moderately slow
Landform: Till plains
Parent material: Glacial till
Slope: 0 to 1 percent
Notes: These soils are highly calcareous and saline.

Taxonomic class: Fine-loamy, mixed, superactive, frigid Typic Calciaquolls

Typical Pedon: (Outside Towner County)
Vallers loam, saline, in an area of Hamerly and Vallers loams, saline, 0 to 3 percent slopes, 2,540 feet south and 1,170 feet west of the northeast corner of sec. 22, T. 163 N., R. 68 W.

Az—0 to 8 inches; black (N 2/0) loam, very dark gray (N 3/0) dry; moderate medium granular structure parting to weak fine granular; slightly hard, friable, slightly sticky and slightly plastic; many very fine and fine roots; common fine flecks of salt; slightly alkaline; few coarse nests of gypsum pedogenic; slightly effervescent throughout (HCl, unspecified); 2 percent mixed gravel; clear wavy boundary.

Bkyzg1—8 to 16 inches; dark gray (5Y 4/1) loam, gray (5Y 5/1) dry; moderate medium and coarse subangular blocky structure parting to moderate fine and medium subangular blocky; hard, friable, moderately sticky and slightly plastic; few very fine roots; common fine flecks of salt; moderately alkaline; many coarse nests of gypsum pedogenic; violently effervescent throughout (HCl, unspecified); 2 percent mixed gravel; clear wavy boundary.

Bkyzg2—16 to 25 inches; olive gray (5Y 4/2) loam, light olive gray (5Y 6/2) dry; moderate medium and coarse subangular blocky structure parting to weak fine and medium subangular blocky; hard, friable, moderately sticky and slightly plastic; few very fine roots; common fine flecks of salt; moderately alkaline; many coarse nests of gypsum pedogenic and few fine distinct grayish brown (2.5Y 5/2) iron depletions pedogenic; violently effervescent throughout (HCl, unspecified); 2 percent mixed gravel; gradual wavy boundary.

Bkyzg3—25 to 33 inches; olive gray (5Y 5/2) clay loam, light gray (5Y 7/2) dry; moderate medium subangular blocky structure parting to moderate fine subangular blocky; hard, firm, moderately sticky and moderately plastic; few very fine roots; common fine flecks of salt; moderately alkaline; coarse nests of gypsum pedogenic and many medium soft masses of lime pedogenic and many fine faint dark gray (5Y 4/1) iron depletions pedogenic and many fine prominent olive brown (2.5Y 4/4) masses of iron accumulation pedogenic; strongly effervescent throughout (HCl, unspecified); 4 percent mixed gravel; clear wavy boundary.

BCkg—33 to 43 inches; olive gray (5Y 5/2) loam, gray (5Y 6/1) dry; weak medium subangular blocky structure parting to weak fine subangular blocky; hard, firm, moderately sticky and moderately plastic; moderately alkaline; common medium soft masses of lime pedogenic and many fine prominent olive brown (2.5Y 4/4) masses of iron accumulation pedogenic and many fine faint olive (5Y 4/3) masses of iron accumulation pedogenic; strongly effervescent throughout (HCl, unspecified); 5 percent mixed gravel; clear wavy boundary.

Cg—43 to 60 inches; dark gray (5Y 4/1) loam, light olive gray (5Y 6/2) dry; massive; hard, firm, moderately sticky and slightly plastic; moderately alkaline; few fine soft masses of lime pedogenic and many medium prominent brown (10YR 4/3) masses of iron accumulation pedogenic and many medium prominent olive brown (2.5Y 4/4) masses of iron accumulation pedogenic; strongly effervescent throughout (HCl, unspecified); 7 percent mixed gravel.

Range in Characteristics

Mollic epipedon thickness: 7 to 17 inches

Az horizon:
Hue: 10YR or neutral
Value: 2 or 3, 3 to 5 dry
Chroma: 0 or 1

Bkyzg horizon:
Hue: 10YR, 2.5Y or 5Y
Value: 3 to 6, 5 to 8 dry
Texture: loam, clay loam or silty clay loam

Cg horizon:
Hue: 2.5Y or 5Y
Value: 4 to 6, 5 to 7 dry
Chroma: 1 to 3
Texture: clay loam or loam

Vang Series

Depth class: Very deep
Drainage class: Well drained
Permeability: Moderate over rapid or very rapid
Landform: Outwash plains and till plains
Parent material: Glaciofluvial deposits
Slope: 1 to 3 percent

Taxonomic class: Fine-loamy over sandy or sandy-skeletal, mixed, superactive Pachic Udic Haploborolls

Typical pedon: (Outside Towner County)
Vang loam, 1,000 feet west and 390 feet south of the northeast corner of sec. 15, T. 162 N., R. 57 W.

Ap—0 to 7 inches; black (10YR 2/1), broken face, loam, very dark gray (10YR 3/1), broken face, dry; weak fine and very fine granular structure; slightly hard, very friable, moderately sticky and moderately plastic; common very fine roots throughout; very strongly acid; abrupt smooth boundary.

A—7 to 11 inches; black (10YR 2/1), broken face, loam, dark gray (10YR 4/1), broken face, dry; weak fine and very fine subangular blocky structure; hard, friable, moderately sticky and moderately plastic; common very fine roots throughout; moderately acid; clear wavy boundary.

Bw1—11 to 19 inches; very dark grayish brown (2.5Y 3/2), broken face, clay loam, dark grayish brown (2.5Y 4/2), broken face, dry; weak medium prismatic structure parting to moderate fine subangular blocky; slightly hard, friable, moderately sticky and moderately plastic; few very fine roots throughout; 5 percent gravel; slightly acid; gradual wavy boundary.

Bw2—19 to 27 inches; very dark grayish brown (2.5Y 3/2), broken face, loam, grayish brown (2.5Y 5/2), broken face, dry; weak fine prismatic structure parting to moderate fine and very fine subangular blocky; slightly hard, very friable, moderately sticky and moderately plastic; few very fine roots throughout; 10 percent gravel; moderately acid; clear wavy boundary.

2C—27 to 60 inches; very dark grayish brown (2.5Y 3/2) very gravelly sand, light brownish gray (2.5Y 6/2) dry; single grain; loose, nonsticky and nonplastic; about 90 percent shale in the 0.1 to 76 mm fraction; 35 percent gravel; neutral.

Range in Characteristics

Mollic epipedon thickness: 16 to 33 inches
Depth to sand and gravel: 20 to 40 inches

Bw horizon
Notes: It has 0 to 10 percent gravel in the upper part and up to 20 percent in the lower part.

2C horizon
Notes: It has more than 20 percent shale in the 0.1 to 76 mm fraction. It averages 30 to 80 percent gravel.

Wyard Series

Depth class: Very deep
Drainage class: Somewhat poorly drained
Permeability: Moderate
Landform: Till plains
Parent material: Alluvium
Slope: 0 to 1 percent

Taxonomic class: Fine-loamy, mixed, superactive, frigid Typic Epiaquolls

Typical pedon: (Outside Towner County)
Wyard loam,1,000 feet north and 200 feet east of the southwest corner of sec. 15, T. 148 N., R. 67 W.

Ap—0 to 6 inches; black (10YR 2/1), broken face, loam, dark gray (10YR 4/1), broken face, dry; weak medium granular structure; hard, friable, slightly sticky and slightly plastic; many fine roots throughout; many worm casts; neutral; abrupt smooth boundary.

A1—6 to 10 inches; black (10YR 2/1), broken face, loam, dark gray (10YR 4/1), broken face, dry; moderate coarse prismatic structure parting to weak coarse subangular blocky and weak medium platy; hard, friable, slightly sticky and slightly plastic; many fine roots throughout; few sand coats on faces of peds; many worm casts; neutral; gradual wavy boundary.

A2—10 to 20 inches; very dark brown (10YR 2/2), broken face, loam, gray (10YR 5/1), broken face, dry; moderate coarse prismatic structure parting to moderate medium and fine subangular blocky and moderate medium platy; hard, friable, slightly sticky and slightly plastic; many fine roots throughout; many fine pores; few patchy gray (10YR 6/1), dry, sand coats on faces of peds and few patchy gray (10YR 6/1), dry, silt coats on faces of peds; few medium distinct yellowish brown (10YR 5/4) masses of iron accumulation

pedogenic throughout; neutral; clear wavy boundary.

Bw1—20 to 26 inches; dark grayish brown (2.5Y 4/2), broken face, loam, grayish brown (2.5Y 5/2), broken face, dry; moderate coarse prismatic structure parting to moderate medium and fine subangular blocky and weak medium platy; hard, friable, slightly sticky and slightly plastic; few roots throughout; many fine pores; common fine prominent yellowish brown (10YR 5/6) masses of iron accumulation pedogenic throughout; neutral; gradual wavy boundary.

Bw2—26 to 32 inches; dark grayish brown (2.5Y 4/2), broken face, loam, light olive brown (2.5Y 5/4), broken face, dry; moderate coarse prismatic structure parting to moderate medium and fine angular blocky; hard, friable, slightly sticky and slightly plastic; few roots throughout; common fine pores; common fine distinct light olive brown (2.5Y 5/6) masses of iron accumulation pedogenic throughout; 2 percent mixed gravel; neutral; clear wavy boundary.

Bk—32 to 42 inches; light olive brown (2.5Y 5/4), broken face, loam, pale yellow (2.5Y 7/4), broken face, dry; weak coarse prismatic structure parting to weak medium subangular blocky; hard, friable, slightly sticky and slightly plastic; few medium distinct light olive brown (2.5Y 5/6) masses of iron accumulation pedogenic and common masses of lime pedogenic; 2 percent mixed gravel; violently effervescent throughout (HCl, unspecified); moderately alkaline; gradual wavy boundary.

C—42 to 60 inches; olive brown (2.5Y 4/4), broken face, loam, light yellowish brown (2.5Y 6/4), broken face, dry; weak medium subangular blocky structure; hard, friable, slightly sticky and slightly plastic; few medium distinct light olive brown (2.5Y 5/6) masses of iron accumulation pedogenic and few fine masses of lime pedogenic; 2 percent mixed gravel; strongly effervescent throughout (HCl, unspecified); moderately alkaline.

Range in Characteristics

Mollic epipedon thickness: 16 to 24 inches
Depth to lime: 20 to 48 inches

Wyndmere Series

Depth class: Very deep
Drainage class: Somewhat poorly drained
Permeability: Moderately rapid or moderately rapid over moderately slow
Landform: Lake plains, outwash plains and delta plains
Parent material: Glaciolacustrine deposits and glaciofluvial deposits
Slope: 0 to 3 percent
Notes: These soils are highly calcareous.

Taxonomic class: Coarse-loamy, mixed, superactive, frigid Aeric Calciaquolls

Typical Pedon
Wyndmere fine sandy loam, 0 to 3 percent slopes, 1,900 feet south and 1,600 feet east of the northwest corner of sec. 19, T. 159 N., R. 65 W.

Ap—0 to 10 inches; black (10YR 2/1) fine sandy loam, very dark gray (10YR 3/1) dry; weak coarse prismatic structure parting to weak coarse granular; soft, very friable, slightly sticky and nonplastic; common very fine and few fine roots; slightly alkaline; strongly effervescent throughout (HCl, unspecified); clear smooth boundary.

Bk1—10 to 18 inches; dark grayish brown (10YR 4/2) fine sandy loam, grayish brown (10YR 5/2) dry; weak coarse prismatic structure parting to weak medium subangular blocky; soft, very friable, slightly sticky and nonplastic; few very fine roots; moderately alkaline; violently effervescent throughout (HCl, unspecified); gradual wavy boundary.

Bk2—18 to 30 inches; dark grayish brown (10YR 4/2) sandy loam, grayish brown (10YR 5/2) dry; weak medium prismatic structure parting to weak coarse subangular blocky; soft, very friable, slightly sticky and nonplastic; few very fine roots; moderately alkaline; common fine faint dark brown (10YR 3/3) masses of iron accumulation pedogenic; strongly effervescent throughout (HCl, unspecified); gradual wavy boundary.

C1—30 to 41 inches; light olive brown (2.5Y 5/3) loamy fine sand, light yellowish brown (2.5Y 6/3) dry; massive; soft, very friable, nonsticky and nonplastic; few very fine roots; slightly alkaline; slightly effervescent throughout (HCl, unspecified); diffuse wavy boundary.

C2—41 to 60 inches; light olive brown (2.5Y 5/3) loamy fine sand, light yellowish brown (2.5Y 6/3) dry; single grain; loose, nonsticky and nonplastic; slightly alkaline; slightly effervescent throughout (HCl, unspecified).

Range in Characteristics

Mollic epipedon thickness: 7 to 16 inches
Depth to silty substratum: Strata of silt loam or silty clay loam are at depths of 40 to 60 inches in some map units.

Ap horizon:
Value: 2 or 3, 3 to 5 dry
Texture: loam or fine sandy loam

Bk horizon:
Hue: 10YR or 2.5Y
Value: 3 to 6, 4 to 8 dry
Chroma: 1 to 4

C horizon:
Hue: 10YR, 2.5Y or 5Y
Value: 4 to 7, 5 to 8 dry
Chroma: 2 to 4

Wyrene Series

Depth class: Very deep
Drainage class: Somewhat poorly drained
Permeability: Moderately rapid over rapid
Landform: Outwash plains
Parent material: Glaciofluvial deposits
Slope: 0 to 3 percent
Notes: These soils are highly calcareous.

Taxonomic class: Sandy, mixed, frigid Aeric Calciaquolls

Typical pedon: (Outside Towner County) Wyrene sandy loam, 2,420 feet south and 1,450 feet west of the northeast corner of sec. 22, T. 148 N., R. 64 W.

A—0 to 8 inches; black (10YR 2/1), broken face, sandy loam, dark gray (10YR 4/1), broken face, dry; weak fine granular structure; slightly hard, very friable, slightly sticky and slightly plastic; many roots throughout; strongly effervescent throughout (HCl, unspecified); moderately alkaline; gradual wavy boundary.

Bk1—8 to 13 inches; dark gray (10YR 4/1), broken face, sandy loam, gray (10YR 6/1), broken face, dry; moderate coarse prismatic structure parting to moderate coarse and medium subangular blocky; hard, friable, slightly sticky and slightly plastic; common roots throughout; violently effervescent throughout (HCl, unspecified); moderately alkaline; gradual wavy boundary.

Bk2—13 to 21 inches; dark gray (10YR 4/1), broken face, sandy loam, gray (10YR 6/1), broken face, dry; moderate coarse and medium prismatic structure parting to moderate coarse and medium subangular blocky; hard, friable, slightly sticky and slightly plastic; few fine roots throughout; violently effervescent throughout (HCl, unspecified); moderately alkaline; clear wavy boundary.

2C1—21 to 29 inches; light olive brown (2.5Y 5/4) coarse sand, light yellowish brown (2.5Y 6/4) dry; single grain; slightly effervescent throughout (HCl, unspecified); moderately alkaline; clear wavy boundary.

2C2—29 to 42 inches; light olive brown (2.5Y 5/4) coarse sand, light yellowish brown (2.5Y 6/4) dry; single grain; common distinct dark yellowish brown (10YR 4/4) masses of iron accumulation pedogenic throughout; 3 percent mixed gravel; slightly effervescent throughout (HCl, unspecified); moderately alkaline; clear wavy boundary.

2C3—42 to 60 inches; very dark grayish brown (2.5Y 3/2) coarse sand, light brownish gray (2.5Y 6/2) and grayish brown (2.5Y 5/2) dry; single grain; 5 percent mixed gravel; slightly effervescent throughout (HCl, unspecified); slightly alkaline.

Range in Characteristics

Mollic epipedon thickness: 7 to 16 inches
Depth to sand and gravel: 20 to 32 inches

A and Bk horizons:
Notes: They have up to 10 percent gravel.

2C horizon:
Notes: It has up to 35 percent gravel.

Zell Series

Depth class: Very deep
Drainage class: Well drained
Permeability: Moderate

Landform: Lake plains
Parent material: Glaciolacustrine deposits
Slope: 3 to 6 percent
Notes: These soils are highly calcareous.

Taxonomic class: Coarse-silty, mixed, superactive Udic Calciborolls

Typical Pedon
Zell silt loam, in an area of Great Bend-Zell silt loams, 3 to 6 percent slopes, 300 feet south and 200 feet west of the northeast corner of sec. 17, T. 158 N., R. 66 W.

Ap—0 to 6 inches; very dark gray (10YR 3/1) silt loam, dark gray (10YR 4/1) dry; moderate fine granular structure; soft, very friable, slightly sticky and slightly plastic; common very fine roots; slightly alkaline; strongly effervescent throughout (HCl, unspecified); clear smooth boundary.

Bk—6 to 12 inches; olive brown (2.5Y 4/4) silt loam, light olive brown (2.5Y 5/4) dry; weak coarse subangular blocky structure parting to weak fine subangular blocky; soft, very friable, slightly sticky and slightly plastic; few very fine roots; moderately alkaline; few medium soft masses of lime pedogenic; strongly effervescent throughout (HCl, unspecified); clear wavy boundary.

C1—12 to 23 inches; light olive brown (2.5Y 5/4) and dark grayish brown (2.5Y 4/2) silt loam, light yellowish brown (2.5Y 6/4) and light brownish gray (2.5Y 6/2) dry; massive; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; moderately alkaline; strongly effervescent throughout (HCl, unspecified); clear wavy boundary.

C2—23 to 33 inches; light olive brown (2.5Y 5/4) and light yellowish brown (2.5Y 6/4) silt loam, light gray (2.5Y 7/2) and pale yellow (2.5Y 7/4) dry; massive; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; moderately alkaline; many fine prominent and medium dark brown (10YR 3/3) masses of iron accumulation relict and many fine and medium distinct dark yellowish brown (10YR 4/4) masses of iron accumulation relict; strongly effervescent throughout (HCl, unspecified); clear wavy boundary.

C3—33 to 60 inches; light olive brown (2.5Y 5/4) silt loam, light yellowish brown (2.5Y 6/4) and light brownish gray (2.5Y 6/2) dry; massive; slightly hard, friable, slightly sticky and slightly plastic; moderately alkaline; many coarse prominent dark brown (10YR 3/3) masses of iron accumulation relict and many coarse distinct dark yellowish brown (10YR 4/4) masses of iron accumulation relict; strongly effervescent throughout (HCl, unspecified).

Range in Characteristics

Mollic epipedon thickness: 7 to 16 inches

Ap horizon:
Value: 2 or 3, 3 or 4 dry

Bk horizon:
Hue: 10YR or 2.5Y
Value: 3 to 6, 5 to 8 dry
Chroma: 2 to 4
Texture: silt loam or very fine sandy loam

C horizon:
Value: 6 to 8 dry
Texture: silt loam or loam

Agronomy

About 94 percent of Towner County is cultivated. In 1995, acreages of the principal close-grown crops were as follows: spring wheat, 100,000 acres; durum wheat, 183,000 acres; winter wheat, 100 acres; barley, 84,000 acres; oats, 1,700 acres; rye, 300 acres; and flax, 1,700 acres. The main row crops were sunflowers and corn. Sunflowers were grown on 7,300 acres, corn for grain was harvested on 100 acres, and corn for silage was harvested on 200 acres. Alfalfa was grown on 2,400 acres and other hay crops on 7,500 acres. Small acreages were planted to potatoes, mustard, buckwheat, lentils, millet, safflower, and soybeans (Beard and Hamlin, 1996).

Cropland limitations and general management practices needed for crops and hay and pasture are discussed in this section. Soil interpretive groups used by the Natural Resources Conservation Service for important farmlands, soil productivity indexes, land capability, pasture and hay, and windbreaks are explained. The management of saline and sodic soils is also discussed.

Planners of management systems for individual fields or farms should consider obtaining specific information from the local office of the Natural Resources Conservation Service or the Cooperative Extension Service.

Cropland Limitations and Management

Management concerns affecting the use of detailed map units in the survey area for crops are shown in Table 6, “Cropland Limitations and Hazards.” The primary concerns in managing cropland are conserving moisture, controlling wind and water erosion and maintaining or improving soil fertility and tilth.

Moisture at planting time is critical to the success of the crop during the growing season. In years where the amount of available soil moisture is low at planting time, crop success for the year is greatly reduced. Measures that reduce evaporation and runoff rates, increase the rate of water infiltration, and control weeds conserve moisture.

Applying conservation tillage and conservation cropping systems, farming on the contour, stripcropping, establishing field windbreaks, trapping snow, and leaving crop residue on the surface also conserve moisture. When fallow is used to carry moisture over to the next season, a cover of crop residue is essential during winter to guard against moisture loss and erosion.

Wind erosion is a hazard on most of the soils in Towner County. It is severe on the coarse textured and moderately coarse textured soils, including Binford, Egeland, Embden, Hecla, Maddock, and Swenoda. Bearden, Buse, Colvin, Divide, Hamerly, Marysland, Vallers, Wyndmere, and Zell soils have a relatively high content of lime and are susceptible to wind erosion in the spring if they have been bare throughout the winter (fig. 5). Because of freezing and thawing, soil structure can break down, resulting in aggregates that are susceptible to movement. Nearly all soils can be damaged by wind erosion if they are not protected by residue.

Water erosion is a severe hazard on gently rolling and steeper soils, such as Barnes, Binford, Buse, Coe, and Svea. The hazard is greatest when the surface is bare.

Conservation practices that control both wind and water erosion are those that maintain a protective cover on the surface. Examples are conservation tillage systems that keep a protective amount of crop residue on the surface. Applications of approved herbicides can help to eliminate the need for summer fallow tillage. Cover crops are also effective in controlling both wind and water erosion. Field windbreaks, annual vegetative barriers, and stripcropping help to control wind erosion. Inclusion of grasses and legumes in the cropping sequence, grassed waterways, diversions, terraces, contour farming, and field stripcropping across the slope help to control water erosion. A management system that includes several measures is the best means of protecting the soil. For example, conservation tillage can control soil blowing during years when the amount of crop residue is adequate, but windbreaks are needed during years when the amount of residue is low.

Measures effective in maintaining or improving soil fertility and tilth include utilizing a nutrient management system that includes applying fertilizer, both organic and inorganic, including manure; incorporating crop

Figure 5. Productivity on the Buse soil on knolls can be reduced by severe wind and water erosion if left unprotected.

residue or green manure crops into the soil; and using proper crop rotations. Wind and water erosion reduce productivity of soils. If the surface layer is lost, most of the available plant nutrients also are lost. As a result, applications of fertilizer are needed to maintain adequate crop production.

Of equal concern is the loss of organic matter through erosion. Soil structure, water infiltration, available water capacity, and tilth are all negatively affected by this loss. As organic matter is lost and the subsoil is exposed and tilled, the remaining soil becomes increasingly susceptible to both wind and water erosion. Controlling erosion helps prevent loss of organic matter and plant nutrients and helps maintain productivity. The level of fertility may be reduced even in areas where erosion is controlled. All soils used for crops generally respond well to a nutrient management system. Proper management of soils includes measures that maintain good tilth. These measures are especially needed on the Aberdeen and Cresbard soils that have a sodic subsoil and on the Fargo and Hegne soils that have a silty clay surface layer. Measures that maintain the content of organic matter are very important if good tilth is to be maintained. The traditional practice of clean-tilled summer fallow contributes to the loss of organic matter because it increases the susceptibility to erosion.

Additional limitations and management practices are as follows:

Alkalinity. This limitation reduces availability of selected nutrients and is associated with restricted seedling emergence and water infiltration. This limitation can be reduced with a nutrient management system and timely tillage operations. Tilling when the soil is neither too wet nor too dry helps to maintain tilth and prevent surface compaction. Maintaining crop residue on the surface and adding organic material to the plow layer help increase organic matter, prevent surface crusting and maintain or improve tilth and fertility.

This limitation exists if the soil's pH is more that 7.8 at the surface.

Areas of rock outcrop. These areas are usually not accessible for cultivation and generally are unsuited to cultivated crops and hay and pasture. Farming around these areas may reduce the impact of this limitation on farming operations.

This limitation exists if "rock outcrop" is included in the name of the map unit.

Channels. These areas consist of meandering streams and oxbows. Most areas are isolated by streams or are irregularly shaped and often have standing water in the spring. These areas generally are unsuited to cultivated crops.

This limitation exists if "channeled" is included in the name of the map unit.

Dense layer. This limitation slows water infiltration and restricts root penetration. It can be managed by using a cropping system that includes deep-rooted legumes, such as alfalfa and sweetclover, and deep tillage to improve root and water penetration. Incorporating organic material into the soil also helps to improve root and water penetration.

This limitation exists if the bulk density is greater than 1.7 in any soil layer.

Depth to rock. This limitation restricts rooting depth. It can be managed by planting shallow-rooted, moisture-efficient crops adapted to the area. A moisture conservation program may be effective on these areas. Some areas that are less than 20 inches to bedrock are not suitable for cultivated crops.

This limitation exists if soft or hard bedrock is within a depth of 40 inches.

Depth to sand and gravel. This limitation restricts rooting depth and may increase the potential for pesticide and nutrient leaching. It can be managed by planting shallow-rooted, moisture-efficient crops adapted to the area. A moisture conservation program may be effective in these areas. Some areas less than 12 inches to sand and gravel are not suitable for cultivated crops.

This limitation exists if there is more than 35 percent gravel in any soil layer at a depth of less than 40 inches.

Excessive permeability. This limitation may cause deep leaching of nutrients and pesticides. A nutrient and pesticide management system with a moisture conservation program, which includes following pesticide labels and fertilizing based on soil nutrient tests, can help manage these areas. Some areas may be unsuitable for cultivated crops.

This limitation exists if the permeability of any soil layer is 6 inches per hour or more.

Flooding. This limitation can affect the timely seeding and survival of crops. In some situations this limitation can be managed by protecting the soil from flooding by diking or by building water retention structures and by planting vegetation that is adapted to flooded conditions. Some areas may be unsuitable for cultivated crops or protection measures may not be economical.

This limitation exists if the map unit is either occasionally flooded for long or very long periods or frequently flooded.

Gullies. This limitation makes cultivation difficult and hazardous. Generally, gullies are so deep that extensive reshaping is necessary for most uses. They generally are unsuited to cultivated crops, hay and pasture.

This limitation exists if "gullied" is included in the name of the map unit.

High sodium content. This limitation restricts root, air and water penetration in the subsoil. It may cause poor tilth and compaction. Tillage at the proper moisture content helps to maintain tilth. Tillage that loosens the dense, sodic subsoil or growing deep-rooted legumes, such as alfalfa and sweetclover, may improve soil physical conditions. For additional information about managing these soils see "Management of Saline and Sodic Soils."

This limitation exists if the sodium absorption ratio (SAR) is more than 15 within a depth of 30 inches or if the soil is classified as an Aridic, Borollic, Leptic, Typic, Udic, or Vertic Natriborolls.

High water table. Wetness in undrained areas can delay tillage, seeding and harvest operations in most years and prevent them in some years. Drained areas are suited to cultivated crops but locating suitable drainage outlets generally is difficult. Planting crops that are tolerant to wetness minimizes the impact of the high water table.

This limitation exists if the water table is within a depth of 36 inches.

Lime content. High lime content at the surface may cause increased wind erosion and surface crusting. It may also reduce availability of selected nutrients. This limitation can be managed by a system of conservation tillage that leaves crop residue on the surface, field windbreaks, stripcropping and annual buffer strips to help control wind erosion. Field windbreaks planted on slopes greater than 8 percent may contribute to water erosion by concentrating spring runoff. Crops may respond well to a nutrient management system that includes additions of phosphate fertilizer.

This limitation exists if the soil is assigned to wind erodibility group 4L or has more than 5 percent lime in the upper 10 inches.

Limited available water capacity. This limitation reduces the capacity of the soil to retain moisture for

plant use. A moisture conservation program can help manage these areas.

This limitation exists if the available water capacity calculated to a depth of 60 inches or to a root-limiting layer is 6 inches or less or the electrical conductivity (EC) is more than 8 at less than 30 inches.

Limited organic matter. This limitation may cause an increase in surface crusting and reduce the soil's natural fertility. Soil organic matter can be managed by utilizing a nutrient management system, incorporating crop residue or green manure crops into the soil and using proper crop rotations.

This limitation exists if the content of organic matter is 1 percent or less in the surface layer.

Ponding. This limitation can affect the timely seeding, harvesting and survival of crops. Because of wetness and ponding, this soil generally is unsuited to cultivated crops, hay and pasture and range.

This limitation exists if ponding occurs on the soil.

Potential for pesticide and nutrient leaching. This limitation increases the hazard of contaminating aquifers, springs and local water tables. A nutrient and pesticide management system with a moisture conservation program, which includes following pesticide labels and fertilizing based on soil nutrient tests, can help manage these areas. Some areas may be unsuitable for cultivated crops.

This limitation exists if the depth to the water table is 48 inches or less, depth to bedrock is less than 60 inches, or permeability of any soil layer is 6 inches per hour or more.

Potential for pesticide and nutrient runoff. This limitation increases the hazard of contaminating surface waters, such as lakes, ponds, steams and rivers. It can be managed with nutrient, pesticide and conservation tillage systems which include leaving crop residue on the surface, following pesticide labels and fertilizing based on soil nutrient testing. Limiting row crops on slopes of more than 8 percent reduces the rate of runoff of pesticides and nutrients.

This limitation exists if the soil is occasionally flooded or frequently flooded; is subject to ponding; is assigned to hydrologic group C or D and has a slope of more than 2 percent; is assigned to hydrologic group A and has a slope of more than 6 percent; or is assigned to hydrologic group B, has a slope of 3 percent or more and has a K factor of more than 0.17.

Potential poor tilth and compaction . This limitation restricts seedling emergence and water infiltration. It can be managed by timely tillage operations, maintaining crop residue on the surface and adding organic material to the plow layer to increase soil organic matter. A cropping system that includes deep-rooted legumes, such as alfalfa and sweetclover, may improve root and water penetration.

This limitation exists if the surface layer of the soil has more than 35 percent clay; has less than 1 percent organic matter; or has SAR of 5 or more.

Restricted permeability. This limitation restricts root penetration and water permeability. It can be managed with timely tillage operations and by using a cropping system that includes deep-rooted legumes, such as alfalfa and sweetclover, to improve root and water penetration. Incorporating organic material into the soil also helps to improve root and water penetration.

This limitation exists if permeability is 0.06 inch per hour or less within a depth of 40 inches.

Root limiting. This limitation reduces the effectiveness of roots when the soil dries and increases moisture stress during extended dry periods. It can be managed with a cropping system that includes deep-rooted legumes, such as alfalfa and sweetclover and deep tillage to improve root and water penetration in the subsoil. Tillage when the soil is neither too wet nor too dry helps to maintain tilth. A moisture conservation system may be beneficial. For additional information about managing these soils see "Management of Saline and Sodic Soils."

This limitation exists if the soil is classified as a Glossic or Glossic Udic Natriborolls.

Salt content. This limitation interferes with plant growth by restricting nutrient uptake and reducing available water. Nutrient management and moisture conservation systems and growing salt-tolerant crops, such as barley, can help manage these areas. For additional information about managing these soils see "Management of Saline and Sodic Soils."

This limitation exists if the soil has a EC of more than 4 in the surface layer or more than 8 within a depth of 30 inches.

Slick spots. The surface of these areas is non-vegetated and tends to puddle upon wetting. Slick spots are restrictive to air and water permeability and root growth. These areas are best suited to range. Because of the dense and massive layers, they generally are unsuited to cultivated crops, hay and pasture. For additional information about managing these soils see "Management of Saline and Sodic Soils."

This limitation exists if "Slick spot" is included in the name of the map unit.

Slope. This limitation increases the potential for accelerated water erosion unless conservation farming practices are applied.

This limitation exists if the upper slope range of the map unit is more than 8 percent.

Soil slumping. This limitation indicates a potential for mass soil movement. These areas generally are unsuited to cultivated crops, hay and pasture.

This limitation exists if the slope is more than 35 percent and the surface or subsoil has more than 35 percent clay; or if bedrock is at a depth of less than 60 inches and the subsoil contains 35 percent clay or more and slope is more than 25 percent; or if "slumped" is a modifier of any named component of the map unit.

Surface crusting. This limitation restricts seedling emergence and water infiltration. It can be managed with a system of conservation tillage that leaves crop residue on the surface and by incorporating organic material into the surface layer.

This limitation exists if the surface texture is silt, silt loam, silty clay loam, or very fine sandy loam and the surface layer organic matter content is less than 3 percent; or if the surface texture is loamy very fine sand, very fine sandy loam, fine sandy loam, sandy loam, sandy clay loam, loam, clay loam, silt, silt loam, or silty clay loam and the surface layer Calcium Carbonate Equivalent (CaCO3) is equal or greater than 1; or if the surface layer SAR is 4 or more.

Surface rock fragments. This limitation adversely affects the use of mechanical equipment for cultivation and causes rapid wear of tillage equipment and difficult seedbed preparation. It cannot be easily overcome. These areas are generally unsuited to cultivated crops, hay and pasture.

This limitation exists if the texture of the surface layer includes any rock fragment modifier except for gravelly or channery and "surface stones" are not already indicated as a limitation.

Surface stones. This limitation restricts normal cultivation practices. These areas are generally unsuited to cultivated crops, hay and pasture. Economic removal of the surface stones generally is not feasible.

This limitation exists if the surface layer texture includes stony or bouldery modifiers or if "Stony" or "Bouldery" are included in the map unit name.

Water Erosion. This limitation indicates an increased hazard of water erosion. This limitation can be managed by a system of conservation tillage that leaves crop residue on the surface, contour stripcropping and grassed waterways in areas where runoff concentrates.

This limitation exists if the surface K factor (soil erodibility factor) multiplied by the upper slope percent is more than 2.

Wind erosion. This limitation indicates an increased hazard of wind erosion. This limitation can be managed by using a system of conservation tillage that leaves crop residue on the surface, field windbreaks, stripcropping, annual crop barriers and a cropping sequence that includes grass-legume hay.

This limitation exists if the wind erodibility group is 1, 2, 3, 4, or 4L.

Erosion Factors

Soil erosion factors are used with other information to estimate the amount of soil lost though water and wind erosion. The procedure for predicting soil loss is useful in guiding and comparing the selection of soil and water conservation practices. The soil erodibility factors (K and Kf), the soil-loss tolerance factor (T), wind erodibility index (I) and wind erodibility groups (WEG) are described in "Physical Properties" in the "Soil Properties" section. Additional information about soil factors affecting wind and water erosion can be obtained from local offices of the Natural Resources Conservation Service or the Cooperative Extension Service.

Prime Farmland and Other Important Farmland

In this section, prime farmland and other important farmland are defined. The map units in the survey area that are considered prime farmland, prime farmland where drained, additional farmland of statewide importance, or other land are listed on Table 7, "Productivity Index and Farmland Designation." Most map units have minor areas or inclusions that do not meet the listed farmland designation. More information about the criteria for prime farmland and other important farmland can be obtained at the local office of the Natural Resources Conservation Service.

Prime farmland is one of several kinds of important farmland defined by the U.S. Department of Agriculture. It is of major importance in meeting the Nation's short- and long-range needs for food and fiber. Because the supply of high-quality farmland is limited, the U.S. Department of Agriculture recognizes that responsible levels of government, as well as individuals, should encourage and facilitate the wise use of our Nation's prime farmland.

Prime farmland, as defined by the U.S. Department of Agriculture, is land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber and oilseed crops and is available for these uses. It could be cultivated land, pastureland, forest land, or other land, but it is not urban, built-up land or water areas. The soil qualities, growing season and moisture supply are those needed for a well managed soil to produce sustained high yields of crops in an economic manner.

Prime farmland has an adequate and dependable supply of moisture from precipitation or irrigation, a favorable temperature and growing season, acceptable acidity or alkalinity, an acceptable salt and sodium content and few or no rocks. It is permeable to water and air. It is not excessively erodible or saturated with water for long periods and it is not frequently flooded during the growing season or it is protected from flooding. The slope ranges mainly from 0 to 6 percent.

Soils with a seasonal high water table may qualify as prime farmland where this limitation is overcome by drainage measures. On-site evaluation is necessary to determine the effectiveness of corrective measures.

A recent trend in land use in some parts of the nation has been the loss of some prime farmland to industrial and urban uses. The loss of prime farmland to other uses puts pressure on marginal lands, which generally are more erodible, droughty and less productive.

About 518,685 acres, or nearly 78 percent of the survey area, meets the requirements for prime farmland. The location of each map unit is shown on the detailed soil maps. The soil qualities that affect use and management are described in the section “Detailed Map Units” and “Soil Series and Their Morphology.”

Additional Farmland of Statewide Importance

Some areas, other than areas of prime farmland, are of statewide importance in the production of food, feed, fiber, forage and oilseed crops. The criteria used in defining and delineating these areas are determined by appropriate state and federal agencies. Generally, additional farmland of statewide importance include areas that nearly meet the criteria for prime farmland and that economically produce high yields of crops when treated and managed with acceptable farming methods. Some areas can produce as high a yield as areas of prime farmland if conditions are favorable.

Other Land

Lands not meeting the criteria for Prime Farmland or Additional Farmland of Statewide Importance are placed into Other Land on Table 7. This group includes Additional Farmland of Local Importance, Unique Farmland and Other Land. These farmlands may have agricultural or non-agricultural uses.

Productivity Indexes and Crop Yield Estimates

Productivity indexes are relative ratings of the ability of a soil to produce a particular crop yield in comparison to other soils. They are useful in estimating long-term average crop yields, comparing the production capacity of soils and in various economic analyses. Productivity indexes are shown in Table 7, “Productivity Index and Farmland Designation.” The average yields per acre that can be expected of the principle crops grown in the county under a high level of management are shown in Table 8, “Yields per Acre of Crops.” Productivity indexes are given for drained conditions and, where applicable, undrained conditions.

Productivity indexes are based on soil properties important to crop production. Knowledgeable and experienced soil scientists, conservationists and university researchers developed the indexes. They used results from field trials, demonstrations and records, and experiences of producers (Ulmer and Patterson, 1988 a, b, c). In North Dakota, productivity indexes are based on long-term average spring wheat production. Similar and contrasting map unit inclusions are considered along with the named map unit components when the productivity index is calculated. The index ranges from 0, which indicates no long term economic production, to 100, which indicates the highest potential production. Productivity indexes are based on the best available information, but they are difficult to determine for soils with variable properties such as salinity, so*(0q.0003 Tc -e4oilorol84 menr)Tj-0.0065 Tc-0.07 T
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or the Cooperative Extension Service can provide information about the management and productivity of the soils for those crops.

Land Capability Classification

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops. Crops that require special management are excluded. Soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops and the way they respond to management. Criteria used in grouping the soils do not take into account extensive and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor do they include unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for rangeland, woodland, or engineering purposes. The capability classification of each map unit is given in Table 9, "Interpretive Groupings Report."

In the land capability system, as described in "Land Capability Classification" (USDA-SCS, 1961), soils generally are grouped at three levels: capability class, subclass and unit. Only class and subclass are used in this survey. Capability classes are given for drained conditions and, where applicable, undrained conditions.

Capability classes, the broadest groups, are designated by numerals 1 through 8. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class 1 soils have few limitations that restrict their use.

Class 2 soils have moderate limitations that reduce the choice of plants or require moderate conservation practices.

Class 3 soils have severe limitations that reduce the choice of plants or require special conservation practices, or both.

Class 4 soils have very severe limitations that reduce the choice of plants and require very careful management, or both.

Class 5 soils are not likely to erode but have other limitations, such as wetness, that are impractical to remove and limit their use.

Class 6 soils have severe limitations that make them generally unsuitable for cultivation.

Class 7 soils have very severe limitations that make them unsuitable for cultivation.

Class 8 soils and miscellaneous areas have limitations that nearly preclude their use for commercial crop production.

Capability subclasses are designated by adding the letter, **E, W, S,** or **C**, to the class numeral, for example, 2E. The letter **E** shows the main hazard is the risk of erosion unless a close-growing plant cover is maintained; **W** shows that water in or on the soil interferes with plant growth or cultivation (in some soils wetness can be partly corrected by artificial drainage); **S** shows the soil is limited mainly because it is droughty, stony, or saline; and **C,** used in only some parts of the United States, shows the chief limitation is climate that is very cold or very dry.

There are no subclasses in class I because soils of this class have few limitations. Class 5 contains only the subclasses indicated by W, S, or C because the soils in class 5 are subject to little or no erosion. They have other limitations that restrict their use mainly to pasture, rangeland, woodland, wildlife habitat, or recreation. There are no subclasses in class 8.

Pasture and Hayland Interpretations

Pastureland is land devoted to the production of adapted introduced or native forage plants for grazing by livestock. Hayland is land primarily used for the production of hay from long-term stands of adapted forage plants. Both pastureland and hayland receive cultural treatments to enhance forage quality and yields. Because of the relatively short growing season, some producers have established cool-season tame pasture to complement the forage produced on rangeland and to extend the grazing season in the spring and fall.

Generally, large amounts of hay are needed to maintain livestock through the long, harsh winters. Hay was harvested on about 14,600 acres in Towner County in 1995 (Beard and Hamlin, 1996.)

Proper pasture or hayland management is essential for the production of high-quality forage, stand survival, and erosion control. Proper grazing management on pastureland during the growing season helps plants maintain sufficient and vigorous top and root growth for sustained production. Brush and weed control is essential in many areas. Fertilizer increases production and enhances longevity of stands. Rotation grazing and renovation also are important management practices.

Soils are assigned to pasture and hayland groups according to their suitability for production of forage under intensive management. Soils in each suitability group are similar enough to be suited to the same species of grasses or legumes. They also have similar limitations and hazards, similar management, and similar productivity levels.

Pasture and hayland suitability groups are given in Table 9, “Interpretive Groupings Report.” They are given for drained conditions and, where applicable, undrained conditions. The local office of the Natural Resources Conservation Service or of the Cooperative Extension Service can provide information on adapted improved varieties and forage yields.

Pasture and Hayland Groups

The following paragraphs describe the Pasture and Hayland Groups in Major Land Resource Area (MLRA) 55A, which includes Towner County. They specify the production potential under improved management and list representative adapted species for each group. The notations in parenthesis following the group name are suitability group reference numbers, often used in lieu of the name.

Clayey (A4) These soils are deep and well, moderately well, and somewhat poorly drained. They are moderately fine and fine textured soils of the uplands. They have few limitations for the management and growth of adapted plants. Production potential is high. Suitable forage species include smooth bromegrass, Russian wildrye, intermediate wheatgrass, western wheatgrass, green needlegrass, big bluestem, indiangrass, switchgrass, alfalfa and sweetclover.

Clayey Subsoils (F1) These soils are deep and moderately well and well drained. They are medium to fine textured soils of the uplands. They have a claypan that is a moderate restriction to root growth. Otherwise, these soils have few limitations for the management and growth of adapted plants. Production potential is moderate to high. Suitable forage species include smooth bromegrass, Russian wildrye, intermediate wheatgrass, western wheatgrass, green needlegrass, switchgrass, alfalfa and sweetclover.

Claypan (G1) These soils are deep and somewhat poorly to well drained. They are moderately coarse to fine textured soils of the uplands. The claypan is dense with very little root penetration. Typically these soils are strongly alkaline in the claypan and below. These soils are saline below 16 inches. Production potential is low. Suitable forage species include western wheatgrass, thickspike wheatgrass, pubescent wheatgrass, slender wheatgrass, alfalfa and sweetclover.

Limy Subirrigated. (A5) These soils are deep and somewhat poorly drained. They are moderately coarse to moderately fine textured, calcareous soils of the uplands. They typically have a water table at about 1.5 to 3.5 feet during spring and early summer. The hazard of wind erosion is a concern during establishment. Production potential is high. Suitable forage species include big bluestem, indiangrass, switchgrass, little bluestem, smooth bromegrass, intermediate wheatgrass, pubescent wheatgrass, tall wheatgrass, slender wheatgrass, sweetclover and birdsfoot trefoil.

Loamy and Silty. (A1) These soils are deep and mostly well and moderately well drained. They are medium textured soils on uplands. They have few limitations for the management and growth of adapted plants. Production potential is high. Suitable forage species include smooth bromegrass, meadow bromegrass, intermediate wheatgrass, pubescent wheatgrass, switchgrass, indiangrass, big bluestem, sideoats grama, slender wheatgrass, alfalfa and sweetclover.

Moderately Deep Silty. (F2) These soils are moderately deep and well drained. They are medium and moderately fine textured soils of the uplands. Weathered siltstone or shale bedrock is at depths of 20 to 40 inches. Root penetration is limited by bedrock. Production potential is moderate to high. Suitable forage species include smooth bromegrass, meadow bromegrass, intermediate wheatgrass, pubescent wheatgrass, western wheatgrass, green needlegrass, sideoats grama, switchgrass, big bluestem, alfalfa and sweetclover.

Overflow and Run-On. (A3) These soils are deep and well to moderately well drained. They are moderately coarse to fine textured soils of floodplains or upland swales and drainageways. Landscapes are typically plane or concave and receive run-on water from adjacent areas. Some soils are subject to flooding. Soils in this group have few limitations for adapted plants. Production potential is high. Suitable forage species include smooth bromegrass, meadow bromegrass, intermediate wheatgrass, pubescent wheatgrass, Russian wildrye, western wheatgrass, thickspike wheatgrass, big bluestem, indiangrass, switchgrass, alfalfa and sweetclover.

Saline. (G4) These soils are deep and somewhat poorly and poorly drained. They are coarse to fine textured, saline soils. The available water capacity is moderate because of salinity. Adapted plant species are those with moderate to high salt tolerance. Severely affected areas will need to be seeded and then mulched to reduce salt concentrations during seedling establishment. The better suited forage species include tall wheatgrass, slender wheatgrass, western wheatgrass, beardless wildrye, alkali sacaton, alsike clover and sweetclover. Late fall, dormant seedings are recommended.

Sands. (A7) These soils are deep and moderately well to excessively drained. They are coarse textured soils of the uplands and floodplains. Wind erosion is a severe hazard during establishment and renovation. Production potential is moderate to high. Species selection is limited for pasture and hayland. Suitable

forage species include sand bluestem, prairie sandreed, little bluestem, intermediate wheatgrass, pubescent wheatgrass and alfalfa.

Sands Soils. (H5) These soils are deep and moderately well to excessively drained. They are very sandy soils. The soils have a very severe wind erosion hazard and are very droughty. They are low in organic matter and very fragile. Blowouts are common. These soils are not suited to pasture and hayland planting. Cultivated areas should be converted to rangeland.

Sandy. (A6) These soils are deep and well and moderately well drained. They are moderately coarse textured soils on uplands and floodplains. The hazard of wind erosion is a concern during establishment and renovation. Production potential is high. Species selection is somewhat limited. Suitable forage species include green needlegrass, slender wheatgrass, western wheatgrass, intermediate wheatgrass, pubescent wheatgrass, prairie sandreed, sand bluestem, switchgrass, alfalfa and sweetclover.

Shallow. (H4) These soils are shallow and well to excessively drained. They are coarse to fine textured soils on uplands. They are less than 20 inches to weathered bedrock and have a severe water erosion hazard. They are not suited to pasture and hayland plantings. Cultivated areas should be converted to rangeland.

Shallow to Gravel. (B1) These soils are deep and well to excessively drained. They are medium to coarse textured soils on outwash plains. They typically have gravel and/or coarse sand at depths from 14 to 24 inches. These soils are droughty. Production potential is moderate. Only drought-tolerant species such as crested wheatgrass, sideoats grama, little bluestem, slender wheatgrass, intermediate wheatgrass and alfalfa should be planted.

Sodic-Saline. (G3) These soils are deep and poorly drained. They are moderately coarse to fine textured claypan soils. These soils occur in drainageways, basins and upland depressions. They typically are strongly alkaline and saline. Plant selection is limited because of the wetness, salinity and alkalinity. Production potential ranges from low to moderate. Establishment is difficult so mulching is recommended on more severely affected areas. Suitable forage species include tall wheatgrass, western wheatgrass, slender wheatgrass, Russian wildrye, beardless wildrye, switchgrass, alkali sacaton, alsike clover and sweetclover. Late fall, dormant seedings are recommended.

Steeply Sloping. (H3) These soil areas are on slopes that average 25 percent or greater. Water erosion is a very severe hazard. These soils are not suited to pasture and hayland plantings. Cultivated areas should be converted to rangeland.

Stony. (H2) These are stony, very stony and extremely stony soils. They are not suited to pasture and hayland plantings. Cultivated areas that have had stone removal should be treated the same as the non-stony phase of the same soil in regard to pasture and hayland planting.

Strongly Saline. (H1) These are deep, poorly drained, moderately fine textured, strongly saline soils. High salinity makes it extremely difficult to establish grass stands. They are not suited to pasture and hayland plantings. Cultivated areas should be converted to rangeland.

Thin Claypan. (G2) These soils are deep and somewhat poorly to well drained. They are medium to fine textured thin claypan soils of the uplands. The claypan is very dense with very little root penetration. Typically they are strongly alkaline in the claypan and below. They are saline within 16 inches of the surface. Production potential is very low to low. Species selection is extremely limited. The best suited forage species include western wheatgrass, slender wheatgrass and beardless wildrye. Where cultivated, returning these soils to rangeland may be a better alternative than pasture or hayland.

Thin Upland. (A2) These soils are deep and well and excessively drained. They are medium textured soils of the uplands. They are on ridges, knobs, and other convex positions subject to runoff. The hazards of wind and water erosion are a concern during establishment. Production potential is moderate. Suitable forage species include smooth bromegrass, intermediate wheatgrass, crested wheatgrass, western wheatgrass, slender wheatgrass, little bluestem, sideoats grama and alfalfa.

Very Shallow to Gravel. (B2) These soils are deep and well to excessively drained. They are medium to moderately coarse textured soils on outwash plains and scoria topped buttes. They typically have coarse sand and gravel or shattered porcelanite at depths of less than 14 inches. These soils are very droughty. Production potential is low and species selection is severely limited. Suitable species include thickspike wheatgrass, crested wheatgrass, little bluestem and sideoats grama. Where cultivated, returning these soils to rangeland may be a better alternative than pasture or hayland.

Wet. (C1) These soils are deep and poorly drained. They are coarse to fine textured soils on floodplains or low areas on till and lake plains. Wetness limits selection of locally adapted forage plants. Production potential is high to very high. Select plant species on

the basis of flooding tolerance or inundation tolerance. Suitable species include reed canarygrass, creeping foxtail, big bluestem, switchgrass, indiangrass, meadow foxtail and alsike clover.

Wetland. (H6) These soils are deep and very poorly drained. They are coarse to fine textured soils. They are usually too wet for cultivation and are not suited to pasture and hayland plantings unless drained. If drained, treat the same as Wet, for pasture and hayland planting.

Management of Saline and Sodic Soils

Saline and sodic soils make up over 7 percent of Towner County. Saline soils make up about 6 percent of the area, or about 46,350 acres, and sodic soils make up less than 1 percent, or about 2,480 acres.

Saline soils have a high concentration of soluble salts, or salts that dissolve in water. Saline soils in Towner County are phases of the Bearden, Colvin, Hamerly, Hegne, and Vallers series.

Saline soils generally develop in areas of restricted drainage, such as those adjacent to sloughs and waterways. Where drainage is poor, salts rise with the water table and are concentrated near the surface. This salt buildup is reduced by plants and a surface cover. The plant roots use the soil water before it can reach the surface and before the salts accumulate. The surface cover prevents evaporation at the surface, the upward movement of water in the soil, and the concentration of salts at the surface (Seelig and Richardson, 1991).

Plants growing on saline soils absorb salts from the soil water. Excess amounts of certain salts may interfere with plant growth. High concentrations of some salts are toxic to certain plants. Some salts cause nutritional imbalances or deficiencies by restricting the uptake or availability of certain plant nutrients. Detecting salinity by visual observations in the field is difficult. The salts are generally not visible during much of the growing season, particularly when the soil is moist. Flecks, threads or masses of soluble salts are usually visible when the soil is dry. Laboratory analysis or special field instruments are needed to determine the actual degree of salinity in soils.

Crop response, particularly during periods of soil moisture stress, is a useful indicator of the degree of salinity in saline soils. For instance, a small grain crop growing on saline soils tends to be stunted and has fewer tillers than small grain on nonsaline soils. Strongly saline soils are best suited to native grasses or to salt-tolerant introduced grasses. Slightly saline or moderately saline soils can produce salt-tolerant crops and forage (fig. 6). Barley is the most salt-tolerant of the small grains. Of the forage crops, tall wheatgrass, western wheatgrass, and alfalfa are salt tolerant once they are established. Continuous cropping is beneficial because it reduces evaporation and salt accumulation in the surface layer.

Sodic soils are characterized by a high content of exchangeable sodium which adheres to the clay particles in the soil (Seelig and Richardson, 1991). The sodic soils in Towner County are phases of the Aberdeen and Cresbard series. Locally, sodic soils are known as “black alkali,” “slick spots,” “pan spots” or “gumbo.”

Sodic soils develop in a complex pattern with a very distinct microrelief. The physical and chemical properties of these soils differ markedly within very short distances. In many areas the distance between the sodic soils and the surrounding soils that have normal physical properties is only a few feet.

Sodic soils developed in areas of saline soils that contained large quantities of sodium salts. Over a long period, usually centuries, as the water table lowers, precipitation gradually leaches the salts from the surface to lower horizons. During this leaching process, the clay in the soil becomes saturated with sodium, disperses, and moves downward with the percolating water. As the moving clay concentrates, a dense, sodic subsoil forms. The dense subsoil is hard when dry, sticky when wet, and nearly impervious to roots, water, and air.

As the leaching by soil water continues, the sodium is gradually moved lower in the soil profile and eventually is carried below rooting depth. The result is a more manageable soil, such as Aberdeen and Cresbard soils. If the leaching process continues and nearly all of the sodium is removed from the profile, the soil eventually changes into a nonsodic soil. This change requires a long period, usually centuries.

If plowed, sodic soils are characterized by a surface layer that is sticky when wet and hard and cloddy when dry. A crust forms easily at the surface. The chemical and physical properties of these soils are unfavorable for plant growth. The harmful effects of the properties on plants generally increase as the sodium content increases. The effects of the reduced amount of water available to plants are more harmful than the toxic effect of the sodium. The plants also are affected by the depth to the dense subsoil.

Identification of sodic soils in cultivated fields commonly is difficult because many of the physical characteristics, such as columnar structure, have been altered by tillage. Crop response, particularly during periods of soil moisture stress, is a useful indicator of the level of sodicity in a soil. Crops grown on soils with varying amounts of sodium exhibit varying heights and

Figure 6. An area of Bearden and Colvin silt loams, saline. Salinity restricts crop growth and the choice of crops. The degree of salinity is indicated by the crop response and occurrence of kochia.

stages of development. If the level of sodicity is very high, the crop cannot grow. The effects of sodium on crop growth are influenced by weather conditions, stage of crop growth, and soil moisture status. A measure of the effect of sodicity on vegetative growth is not necessarily a reliable measure of crop yields. In many areas the yields of barley and wheat are affected less than the vegetative growth of these crops.

Variability of sodic soils can cause management problems. Soils that have a dense, sodic subsoil near the surface are better suited to grass than to small grain and sunflower.

Timely tillage is an important management need in areas of sodic soils. These areas should be tilled and seeded only when the moisture content is favorable. If worked when too wet, the soils puddle and crust. If the soils are tilled when too dry, tillage and seeding implements cannot easily penetrate the soils. Deep plowing and chemical amendments can help to reclaim sodic soils, but they may not be feasible. To be effective, deep tillage should reach below the sodic subsoil and mix several inches of the underlying material with the subsoil and topsoil. Depending on the soil, tillage to a depth of 15 to 36 inches may be needed. Any reclamation of sodic soils is a long-term endeavor. Complete reclamation may never be achieved. On-site investigation is needed to confirm the feasibility of deep tillage in a particular area.

Saline-sodic soils develop in areas of restricted drainage where salts rise with the water table but where some downward leaching of clay and some saturation with sodium are evident and a dense, sodic subsoil has formed. The management needs and crop responses on these soils are a combination of those on saline soils and those on sodic soils.

Additional information about management or reclamation of saline and sodic soils is available from the Natural Resources Conservation Service, the North Dakota Agricultural Experiment Station, and the Cooperative Extension Service (Franzen, et. al., 1994).

Woodland, Windbreaks and Environmental Plantings

Towner County has limited acreage of native woodland. Most of this woodland is scattered across

the county surrounding wetlands and lakes. Trees and shrubs also occur to a limited degree along the Mauvais Coulee that drains into the Devils Lake basin.

The principal species in the woodland fringe of the wetlands are quaking aspen, various willow species, and redosier dogwood. Forest types along drainageways are primarily American elm, green ash, boxelder, and various willow species. Other less common species include cottonwood, common chokecherry, and redosier dogwood.

Windbreaks protect livestock, buildings and yards from wind and snow. They also protect fruit trees and gardens and they furnish habitat for wildlife. Several rows of low- and high-growing broadleaf and coniferous trees and shrubs provide the most protection.

Field windbreaks are narrow tree/shrub rows interspersed with cropland at specified intervals. Field windbreaks oriented perpendicular to the prevailing winds are the most efficient. Intervals depend on the erodibility of the soil. Field windbreaks protect cropland and crops from wind, help to keep snow on fields and provide food and cover for wildlife (fig. 7).

Environmental plantings help to beautify and screen houses and other buildings and to abate noise. The plants, mostly evergreen shrubs and trees, are closely spaced. To ensure plant survival, a healthy planting stock of suitable species should be planted properly on a well prepared site and maintained in good condition.

The following items should be considered before a planting is made: purpose of the planting, suitability of various species of trees and shrubs to the soils and climate, location and design of the windbreak and selection of hardy seedlings. If these items are not considered, a poor, unsuccessful windbreak may result.

Establishment of a windbreak or an environmental planting and growth of trees and shrubs also depend on suitable site preparation and adequate maintenance after the trees and shrubs are planted. Grasses and weeds should be eliminated before the trees and shrubs are planted and competing ground cover should be controlled for the life of the windbreak. Some replanting may be necessary during the first two years after the trees and shrubs are planted.

Figure 7. Alfalfa on an area of Swenoda fine sandy loam, 0 to 6 percent slopes. The windbreaks help keep the soil from blowing.

Windbreaks are often planted on land that did not originally support trees. Knowledge of how trees perform on such land can be gained only by observing and recording the performance of trees that have been planted and have survived. Many popular windbreak species are not indigenous to the areas in which they are planted.

Each tree or shrub species has certain climatic and physiographic limits. Within these parameters, a tree or shrub may grow well or grow poorly, depending on the characteristics of the soil. **Windbreak suitability groups** consist of soils in which the kinds and degrees of hazards and limitations that affect the survival and growth of trees and shrubs in windbreaks are similar. They are a guide for selecting species best suited for different kinds of soils. Windbreak suitability groups are shown for each soil in Table 9, "Interpretive Groupings Report." They are given for drained conditions and, where applicable, undrained conditions.

Each tree or shrub has definable potential heights in a given physiographic area and under a given climate. Accurate definitions of potential heights are necessary when a windbreak is planned and designed.

Table 10, "Windbreak Suitability Groups," shows the height locally grown trees and shrubs are expected to reach in 20 years on various soils. Estimates in this table are based on measurements and observations of established plantings that have been given adequate care. They can be used as a guide in planning windbreaks and screens. Additional information on planning windbreaks and screens and planting and caring for trees and shrubs can be obtained from local offices of the Natural Resources Conservation Service or the Cooperative Extension Service or from a nursery.

Windbreak Suitability Groups

The following paragraphs describe the windbreak suitability groups.

Group 1. These are very deep, well to somewhat poorly drained soils that receive beneficial moisture from favorable landscape positions, flooding, or runoff from adjacent land. They may also have a beneficial seasonally high water table during the spring. Competition from grass and weeds is the principal concern in establishing and managing trees and shrubs. Occasionally, somewhat poorly drained soils may have excessive water for some species.

Group 1K. These are very deep, calcareous, well to somewhat poorly drained soils on low rises near wetlands that receive beneficial moisture from favorable landscape positions or have a beneficial seasonally high water table during the spring. High calcium carbonate content will have an effect on the selection of species on soils in this group. Competition from grass and weeds is the principal concern in establishing and managing trees and shrubs. Occasionally, somewhat poorly drained soils may have excessive water for some species. Wind erosion is a concern on these soils.

Group 2. Soils in this group are very deep, poorly or very poorly drained and excessively wet or ponded during the spring or overflow periods. Wetness and drainage will have an effect on the selection of tree and shrub species for soils in this group. Competition from grass and weeds is the principal concern in establishing and managing trees and shrubs. Spring planting may be delayed because of wet conditions. Wind erosion is a concern on the sandy and organic soils in this group.

Group 2H. Soils in this group are very deep, have an organic mat about 24 inches thick, are poorly or very poorly drained and excessively wet or ponded during the spring or overflow periods. Wetness and drainage will have an effect on the selection of tree and shrub species for soils in this group. Competition from grass and weeds is the principal concern in establishing and managing trees and shrubs. Spring planting may be delayed because of wet conditions. Wind erosion is a concern on these soils.

Group 2K. Soils in this group are very deep, calcareous, poorly or very poorly drained, on rims of potholes and broad flats that are excessively wet or ponded during the spring or overflow periods. Wetness, high calcium carbonate content and drainage will have an effect on the selection of tree and shrub species for soils in this group. Competition from grass and weeds is the principal concern in establishing and managing trees and shrubs. Spring planting may be delayed because of wet conditions. Wind erosion is a concern on these soils.

Group 3. Soils in this group are very deep, well drained, loamy textured soils with moderate and moderately slow permeability on uplands. Competition from grass and weeds is the principal concern in establishing and managing trees and shrubs on these soils. Water erosion is a concern on the gently sloping to moderately steep areas.

Group 4. Soils in this group are moderately deep to very deep, have loamy surface textures with clayey subsoils, have slow or very slow permeability and occur on uplands. High clay content has an affect on the selection of tree and shrub species for these soils. Competition from grass and weeds is the principal

concern in establishing and managing trees and shrubs on these soils. Water erosion is a concern on the gently sloping to moderately steep areas.

Group 4C. Soils in this group are moderately deep to very deep, clayey throughout, have slow or very slow permeability and occur on uplands. High clay content has an effect on the selection of tree and shrub species for these soils. Competition from grass and weeds is the principal concern in establishing and managing trees and shrubs on these soils. Wind erosion is a concern on these soils and water erosion is a concern on the gently sloping to moderately steep areas.

Group 5. Soils in this group are very deep with loamy and sandy textures. This group typically includes soils that normally have adequate soil moisture. Competition from grass and weeds and abrasion from wind erosion are the principal concerns in establishing and managing trees and shrubs on these soils.

Group 6D. Soils in this group are well drained, mostly loamy textured and moderately deep over bedrock and other cemented layers that can severely restrict root growth. They have low or moderate available water capacity. Droughtiness will have an effect on the selection of tree and shrub species for use on these soils. Competition from grass and weeds is the principal concern in establishing and managing trees and shrubs on these soils. Water erosion is a concern on the gently sloping to moderately steep areas. Supplemental watering may be needed for establishment.

Group 6G. Soils in this group are well drained, mostly loamy textured and moderately deep over sand and gravel. The sand and gravel can restrict root growth and reduce available water capacity. Droughtiness will have an effect on the selection of tree and shrub species for use on these soils. Competition from grass and weeds is the principal concern in establishing and managing trees and shrubs on these soils. Water erosion is a concern on the gently sloping to moderately steep areas. Supplemental watering may be needed for establishment.

Group 7. Soils in this group are very deep, excessively to moderately well drained, and sandy textured. They typically have low to very low available water capacity and do not normally have adequate moisture. Drought conditions and abrasion from wind erosion are the principal concerns in establishing and managing trees and shrubs on these soils. Specialized site preparation and planting methods (vegetation between the rows is normally left undisturbed) are needed to establish trees and shrubs. Supplemental watering may be essential for successful establishment.

Group 8. Soils in this group are calcareous at or near the surface. They do not receive beneficial moisture from run-on, flooding, or seasonal high water tables. High calcium carbonate content and competition from grass and weeds are the principal concerns in establishing and managing trees and shrubs on these soils. Wind erosion is a concern on these soils and water erosion is a concern on gently sloping to moderately steep areas.

Group 9C. Soils in this group are clayey and affected by salinity and/or sodicity. These soils do not have a seasonal high water table. Concentrations of salt will severely affect the establishment, vigor and growth of trees and shrubs on these soils.

Group 9L. Soils in this group are loamy and affected by salinity and/or sodicity. These soils do not have a seasonal high water table. Concentrations of salt will severely affect the establishment, vigor and growth of trees and shrubs on these soils.

Group 9W. Soils in this group are affected by salinity and/or sodicity and have a high water table. Concentrations of salt will severely affect the establishment, vigor and growth of trees and shrubs on these soils.

Group 10. Soils in this group have one or more characteristics such as soil depth, texture, drainage, channeled phases, available water capacity, slope or salt toxicity which severely limit planting, survival or growth of trees and shrubs. Soils in this group are usually not recommended for farmstead and feedlot windbreaks, field windbreaks and plantings for recreation and wildlife. However, on-site investigations may reveal tree and shrub plantings can be made with special treatments (hand planting, no-till planting, scalp planting, specialized site preparation, drainage, or other specialized treatments). Selection of species must be tailored to soil conditions existing at each site.

All soils on moderately steep, steep, or very steep slopes (generally 15 percent or more) and soils that are generally too wet, too shallow, or have other severely restrictive conditions fall into group 10. When an on-site investigation reveals a planting can be made on a soil in group 10, species should be selected from the most comparable windbreak suitability group. For example, for a shallow soil over bedrock, trees or shrubs would be selected from group 6D; an excessively wet soil would most closely match group 2.

Table 6.—Cropland Limitations and Hazards

(See text for a description of the limitations and hazards listed in this table.)

Soil name and map symbol	Cropland limitations or hazards
118:	
Barnes	Potential for pesticide and nutrient runoff
Buse	Alkalinity Lime content Potential for pesticide and nutrient runoff Surface crusting Wind erosion
120:	
Barnes	Potential for pesticide and nutrient runoff Slope Water erosion
Buse	Alkalinity Lime content Potential for pesticide and nutrient runoff Slope Surface crusting Water erosion Wind erosion
154:	
Barnes	None
Svea	Potential for pesticide and nutrient leaching
167:	
Bearden	Alkalinity High water table Lime content Potential for pesticide and nutrient leaching Restricted permeability Surface crusting Wind erosion
314:	
Buse	Alkalinity Lime content Potential for pesticide and nutrient runoff Slope Surface crusting Water erosion Wind erosion
Barnes	Potential for pesticide and nutrient runoff Slope Water erosion
450:	
Colvin	Alkalinity High water table Lime content Potential for pesticide and nutrient leaching Surface crusting Wind erosion

Table 6.—Cropland Limitations and Hazards--Continued

(See text for a description of the limitations and hazards listed in this table.)

Soil name and map symbol	Cropland limitations or hazards
511:	
Divide	Alkalinity Depth to sand and gravel Excessive permeability High water table Lime content Potential for pesticide and nutrient leaching Surface crusting Wind erosion
553:	
Egeland	Excessive permeability Potential for pesticide and nutrient leaching Wind erosion
Embden	Excessive permeability Potential for pesticide and nutrient leaching Wind erosion
846:	
Great Bend	None
Overly	Potential for pesticide and nutrient leaching Restricted permeability
871:	
Hamerly	Alkalinity High water table Lime content Potential for pesticide and nutrient leaching Potential for pesticide and nutrient runoff Surface crusting Wind erosion
Cresbard	Potential for pesticide and nutrient leaching Restricted permeability Root limiting
883:	
Hamerly	Alkalinity High water table Lime content Potential for pesticide and nutrient leaching Potential for pesticide and nutrient runoff Surface crusting Wind erosion
Tonka	High water table Ponding Potential for pesticide and nutrient leaching Potential for pesticide and nutrient runoff Restricted permeability
Parnell	High water table Ponding Potential for pesticide and nutrient leaching Potential for pesticide and nutrient runoff Potential poor tilth and compaction Restricted permeability

Table 6.—Cropland Limitations and Hazards--Continued

(See text for a description of the limitations and hazards listed in this table.)

Soil name and map symbol	Cropland limitations or hazards
926:	
Hecla	Excessive permeability Limited available water capacity Potential for pesticide and nutrient leaching Wind erosion
966:	
Hegne	Alkalinity High water table Lime content Limited available water capacity Potential for pesticide and nutrient leaching Potential poor tilth and compaction Restricted permeability Salt content Wind erosion
971	
Hegne	Alkalinity High water table Lime content Potential for pesticide and nutrient leaching Potential poor tilth and compaction Restricted permeability Wind erosion
Fargo	High water table Lime content Potential for pesticide and nutrient leaching Potential poor tilth and compaction Restricted permeability Wind erosion
1221:	
Maddock	Excessive permeability Limited available water capacity Potential for pesticide and nutrient leaching Wind erosion
Hecla	Excessive permeability Limited available water capacity Potential for pesticide and nutrient leaching Wind erosion
1267:	
Marysland	Alkalinity Depth to sand and gravel Excessive permeability High water table Lime content Potential for pesticide and nutrient leaching Surface crusting Wind erosion
1426:	
Parnell	High water table Ponding Potential for pesticide and nutrient leaching Potential for pesticide and nutrient runoff Potential poor tilth and compaction Restricted permeability

Table 6.—Cropland Limitations and Hazards--Continued

(See text for a description of the limitations and hazards listed in this table.)

Soil name and map symbol	Cropland limitations or hazards
1466:	
Pits, gravel and sand	Alkalinity Depth to sand and gravel Excessive permeability Limited organic matter Potential for pesticide and nutrient leaching Potential for pesticide and nutrient runoff Slope Surface crusting Surface rock fragment Water erosion
1710:	
Southam	Alkalinity High water table Lime content Ponding Potential for pesticide and nutrient leaching Potential for pesticide and nutrient runoff Potential poor tilth and compaction Restricted permeability Salt content Wind erosion
1782:	
Swenoda	Excessive permeability Potential for pesticide and nutrient leaching Potential for pesticide and nutrient runoff Wind erosion
1884:	
Vallers	Alkalinity High water table Lime content Limited available water capacity Potential for pesticide and nutrient leaching Salt content Surface crusting Wind erosion
Parnell	High water table Ponding Potential for pesticide and nutrient leaching Potential for pesticide and nutrient runoff Potential poor tilth and compaction Restricted permeability
1886:	
Hamerly	Alkalinity High water table Lime content Limited available water capacity Potential for pesticide and nutrient leaching Potential for pesticide and nutrient runoff Salt content Surface crusting Wind erosion

Table 6.—Cropland Limitations and Hazards--Continued

(See text for a description of the limitations and hazards listed in this table.)

Soil name and map symbol	Cropland limitations or hazards
1886:	
Vallers	Alkalinity High water table Lime content Limited available water capacity Potential for pesticide and nutrient leaching Salt content Surface crusting Wind erosion
1978:	
Water	Nonsoil material
2048:	
Wyndmere	Alkalinity Excessive permeability High water table Lime content Potential for pesticide and nutrient leaching Surface crusting Wind erosion
2151:	
Binford	Depth to sand and gravel Excessive permeability Limited available water capacity Potential for pesticide and nutrient leaching Potential for pesticide and nutrient runoff Wind erosion
Coe	Depth to sand and gravel Excessive permeability Limited available water capacity Potential for pesticide and nutrient leaching Potential for pesticide and nutrient runoff Surface crusting Wind erosion
2196:	
Bearden	Alkalinity High water table Lime content Limited available water capacity Potential for pesticide and nutrient leaching Salt content Surface crusting Wind erosion
Colvin	Alkalinity High water table Lime content Limited available water capacity Potential for pesticide and nutrient leaching Salt content Surface crusting Wind erosion

Table 6.—Cropland Limitations and Hazards--Continued

(See text for a description of the limitations and hazards listed in this table.)

Soil name and map symbol	Cropland limitations or hazards
2208:	
Brantford	Depth to sand and gravel Excessive permeability Limited available water capacity Potential for pesticide and nutrient leaching Potential for pesticide and nutrient runoff
Coe	Depth to sand and gravel Excessive permeability Limited available water capacity Potential for pesticide and nutrient leaching Surface crusting
2286	
Aberdeen	Potential for pesticide and nutrient leaching Restricted permeability Root limiting
Bearden	Alkalinity High water table Lime content Potential for pesticide and nutrient leaching Surface crusting Wind erosion
2287:	
Bearden	Alkalinity High water table Lime content Potential for pesticide and nutrient leaching Surface crusting Wind erosion
Lindaas	High water table Ponding Potential for pesticide and nutrient leaching Potential for pesticide and nutrient runoff Restricted permeability
2288:	
Brantford	Depth to sand and gravel Excessive permeability Limited available water capacity Potential for pesticide and nutrient leaching
Divide	Alkalinity Depth to sand and gravel Excessive permeability High water table Lime content Potential for pesticide and nutrient leaching Surface crusting Wind erosion
2289:	
Buse	Alkalinity Lime content Potential for pesticide and nutrient runoff Slope Surface crusting Water erosion Wind erosion

Table 6.—Cropland Limitations and Hazards--Continued

(See text for a description of the limitations and hazards listed in this table.)

Soil name and map symbol	Cropland limitations or hazards
2289:	
Svea	Potential for pesticide and nutrient runoff Slope Water erosion
Lamoure	Alkalinity Flooding High water table Lime content Potential for pesticide and nutrient leaching Potential for pesticide and nutrient runoff Wind erosion
2290:	
Coe	Depth to sand and gravel Excessive permeability Limited available water capacity Potential for pesticide and nutrient leaching Potential for pesticide and nutrient runoff Slope Surface crusting Water erosion Wind erosion
Binford	Depth to sand and gravel Excessive permeability Limited available water capacity Potential for pesticide and nutrient leaching Potential for pesticide and nutrient runoff Slope Water erosion Wind erosion
2291:	
Great Bend	Potential for pesticide and nutrient runoff
Zell	Alkalinity Lime content Potential for pesticide and nutrient runoff Surface crusting Wind erosion
2292:	
Hamerly	Alkalinity High water table Lime content Potential for pesticide and nutrient leaching Potential for pesticide and nutrient runoff Surface crusting Wind erosion
Barnes	None
2293:	
Lamoure	Alkalinity Channeled Flooding High water table Lime content Potential for pesticide and nutrient leaching Potential for pesticide and nutrient runoff Wind erosion

Table 6.—Cropland Limitations and Hazards--Continued

(See text for a description of the limitations and hazards listed in this table.)

Soil name and map symbol	Cropland limitations or hazards
2293:	
Colvin	Alkalinity Channeled Flooding High water table Lime content Potential for pesticide and nutrient leaching Potential for pesticide and nutrient runoff Surface crusting Wind erosion
2324:	
Wyndmere	Alkalinity Excessive permeability High water table Lime content Potential for pesticide and nutrient leaching Surface crusting Wind erosion
Tiffany	High water table Excessive permeability Potential for pesticide and nutrient leaching

Table 7.—Productivity Index and Farmland Designation

(Dashes (—) indicate that an assignment has not been made.
Entries in ( ) are for undrained conditions.)

Map symbol	Spring wheat productivity index	Farmland designation
118	73	Prime farmland
120	52	Additional farmland of statewide importance
154	86	Prime farmland
167	89	Prime farmland
314	37	Other land
450	69(42)	Prime farmland where drained
511	67	Prime farmland
553	74	Prime farmland
846	92	Prime farmland
871	78	Additional farmland of statewide importance
883	83(60)	Prime farmland where drained
926	52	Other land
966	40(20)	Other land
971	83(40)	Prime farmland where drained
1221	48	Other land
1267	60(34)	Prime farmland where drained
1426	70(29)	Other land
1466	—	Other land
1710	42(0)	Other land
1782	68	Prime farmland
1884	46(26)	Other land
1886	51(43)	Other land
1978	—	Water
2048	66	Prime farmland
2151	36	Other land
2196	56(45)	Other land
2208	40	Other land
2286	81	Additional farmland of statewide importance

Table 7.—Productivity Index and Farmland Designation--Continued

(Dashes (—) indicate that an assignment has not been made.
Entries in ( ) are for undrained conditions.)

Map symbol	Spring wheat productivity index	Farmland designation
2287	90(71)	Prime farmland where drained
2288	56	Other land
2289	25	Other land
2290	30	Other land
2291	66	Prime farmland
2292	84	Prime farmland
2293	37(24)	Other land
2324	80	Prime farmland where drained

Table 8.—Yields per Acre of Crops

(Yields are those that can be expected under a high level of nonirrigated management. They are given by map unit. Presence of a yield does not indicate the soil is suited to the crop nor does it imply a positive economical return. Dashes [—] indicate that a yield is not assigned. Entries in ( ) are for undrained conditions.)

Map symbol and soil name	Wheat, spring —Bu/A—	Oats —Bu/A—	Barley —Bu/A—	Flax —Bu/A—	Sun-flower —Lbs/A—	Bromegrass alfalfa hay —T/A—
118: Barnes Buse	29	62	47	15	1450	2.3
120: Barnes Buse	21	45	34	11	1050	2.0
154: Barnes Svea	34	72	55	17	1700	2.7
167: Bearden	36	78	59	18	1800	2.3
314: Buse Barnes	15	32	24	8	750	1.9
450: Colvin	28 (17)	60 (36)	46 (28)	14 (9)	1400 (850)	2.3 (2.7)
511: Divide	27	57	44	14	1350	2.3
553: Egeland Embden	30	64	49	15	1500	2.1
846: Great Bend Overly	37	79	60	19	1850	2.7
871: Hamerly Cresbard	31	66	50	16	1550	2.0
883: Hamerly Tonka Parnell	33 (24)	70 (51)	54 (39)	17 (12)	1650(1200)	2.4 (2.1)
926: Hecla	21	45	34	11	1050	1.8
966: Hegne	16 (8)	34 (17)	26 (13)	8 (4)	800 (400)	2.1 (2.2)

Table 8.—Yields per Acre of Crops--Continued

(Yields are those that can be expected under a high level of nonirrigated management. They are given by map unit. Presence of a yield does not indicate the soil is suited to the crop nor does it imply a positive economical return. Dashes [—] indicate that a yield is not assigned. Entries in ( ) are for undrained conditions.)

Map symbol and soil name	Wheat, spring —Bu/A—	Oats —Bu/A—	Barley —Bu/A—	Flax —Bu/A—	Sun-flower —Lbs/A—	Bromegrass alfalfa hay —T/A—
971: Hegne Fargo	33 (16)	70 (34)	54 (26)	17 (8)	1650 (800)	2.2 (2.8)
1221: Maddock Hecla	19	40	31	10	950	1.8
1267: Marysland	24 (14)	51 (30)	39 (23)	12 (7)	1200 (700)	2.3 (2.8)
1426: Parnell	28 (12)	60 (26)	46 (20)	14 (6)	1400 (600)	2.8 (0)
1466: Pits, gravel and sand	—	—	—	—	—	—
1710: Southam	17 (0)	36 (0)	28 (0)	9 (0)	850 (0)	2.8 (0)
1782: Swenoda	27	57	44	14	1350	2.1
1884: Vallers Parnell	18 (10)	38 (21)	29 (16)	9 (5)	900 (500)	2.4 (1.5)
1886: Hamerly Vallers	20 (17)	43 (36)	33 (28)	10 (9)	1000 (850	2.2 (2.2)
1978: Water	—	—	—	—	—	—
2048: Wyndmere	26	55	42	13	1300	2.3
2151: Binford Coe	14	30	23	7	700	1.4
2196: Bearden Colvin	22 (18)	47 (38)	36 (29)	11 (9)	1100 (900)	2.2 (2.2)

Table 8.—Yields per Acre of Crops--Continued

(Yields are those that can be expected under a high level of nonirrigated management. They are given by map unit. Presence of a yield does not indicate the soil is suited to the crop nor does it imply a positive economical return. Dashes [—] indicate that a yield is not assigned. Entries in ( ) are for undrained conditions.)

Map symbol and soil name	Wheat, spring —Bu/A—	Oats —Bu/A—	Barley —Bu/A—	Flax —Bu/A—	Sun-flower —Lbs/A—	Bromegrass alfalfa hay —T/A—
2208: Brantford Coe	16	34	26	8	800	1.4
2286: Aberdeen Bearden	32	68	52	16	1600	1.9
2287: Bearden Lindaas	36 (28)	77 (60)	59 (46)	18 (14)	1800(1400)	2.3 (2.5)
2288: Brantford Divide	22	47	36	11	1100	2.0
2289: Buse Svea Lamoure	10	21	16	5	500	1.7
2290: Coe Binford	12	26	20	6	600	1.4
2291: Great Bend Zell	26	55	42	13	1300	2.0
2292: Hamerly Barnes	34	72	55	17	1700	2.4
2293: Lamoure Colvin	15 (10)	32 (21)	24 (16)	8 (5)	750 (500)	2.3 (2.8)
2324: Wyndmere Tiffany	32	68	52	16	1600	2.5

Table 9.—Interpretive Groupings Report

(Dashes (—) indicate an interpretive group is not assigned. Entries in ( ) are for undrained conditions. Range sites are for undrained conditions.)

Map symbol and soil name	Pasture and hayland suitability group	Land capability class	Windbreak suitability group
118:			
Barnes	Loamy and Silty A1	2E	3
Buse	Thin Upland A2	3E	8
120:			
Barnes	Loamy and Silty A1	3E	3
Buse	Thin Upland A2	4E	8
154:			
Barnes	Loamy and Silty A1	2C	3
Svea	Overflow and Runon A3	2C	1
167:			
Bearden	Limy Subirrigated A5	2E	1K
314:			
Buse	Thin Upland A2	6E	10
Barnes	Loamy and Silty A1	4E	3
450:			
Colvin	Limy Subirrigated A5 (Wet C1)	2W(4W)	1K(2K)
511:			
Divide	Limy Subirrigated A5	2E	1K
553:			
Egeland	Sandy A6	3E	5
Embden	Overflow and Runon A3	3E	1
846:			
Great Bend	Loamy and Silty A1	2C	3
Overly	Overflow and Runon A3	2C	1
871:			
Hamerly	Limy Subirrigated A5	2E	1K
Cresbard	Clayey Subsoils F1	2S	4
883:			
Hamerly	Limy Subirrigated A5	2E	1K
Tonka	Clayey A4 (Wet C1)	2W(4W)	1(2)
Parnell	Wet C1 (Wetland H6)	3W(5W)	2(10)
926:			
Hecla	Sands A7	4E	7
966:			
Hegne	Saline G4	3S	9W
971:			
Hegne	Clayey A4 (Wet C1)	2W(4W)	1K(2K)
Fargo	Clayey A4 (Wet C1)	2W(4W)	4C(2)
1221:			
Maddock	Sands A7	4E	7
Hecla	Sands A7	4E	7

Table 9.—Interpretive Groupings Report--Continued

(Dashes (—) indicate an interpretive group is not assigned. Entries in ( ) are for undrained conditions. Range sites are for undrained conditions.)

Map symbol and soil name	Pasture and hayland suitability group	Land capability class	Windbreak suitability group
1267:			
Marysland-------	Limy Subirrigated A5 (Wet C1)	2W(4W)	1K(2K)
1426:			
Parnell---------	Wet C1 (Wetland H6)	3W(5W)	2(10)
1466:			
Pits, gravel---- and sand	—	8S	—
1710:			
Southam---------	Wet C1 (Wetland H6)	3W(8W)	2K(10)
1782:			
Swenoda---------	Sandy A6	3E	1
1884:			
Vallers---------	Saline G4	3S	9W
Parnell---------	Wet C1 (Wetland H6)	3W(5W)	2(10)
1886:			
Hamerly---------	Saline G4	3S	9W
Vallers---------	Saline G4	3S	9W
1978:			
Water-----------	—	--	--
2048:			
Wyndmere--------	Limy Subirrigated A5	3E	1K
2151:			
Binford---------	Shallow to Gravel B1	3E	6G
Coe-------------	Very Shallow to Gravel B2	6S	10
2196:			
Bearden---------	Saline G4	3S	9W
Colvin----------	Saline G4	3S	9W
2208:			
Brantford-------	Shallow to Gravel B1	3E	6G
Coe-------------	Very Shallow to Gravel B2	6S	10
2286:			
Aberdeen--------	Clayey Subsoils F1	2S	4
Bearden---------	Limy Subirrigated A5 (Wet C1)	2E	1K
2287:			
Bearden---------	Limy Subirrigated A5	2E	1K
Lindaas---------	Clayey A4 (Wet C1)	2W(4W)	1(2)

Table 9.—Interpretive Groupings Report--Continued

(Dashes (—) indicate an interpretive group is not assigned. Entries in ( ) are for undrained conditions. Range sites are for undrained conditions.)

Map symbol and soil name	Pasture and hayland suitability group	Land capability class	Windbreak suitability group
2288:			
Brantford	Shallow to Gravel B1	3S	6G
Divide	Limy Subirrigated A5	2S	1K
2289:			
Buse	Steeply Sloping H3	7E	10
Svea	Loamy and Silty A1	4E	10
Lamoure	Limy Subirrigated A5 (Wet C1)	6W	10
2290:			
Coe	Very Shallow to Gravel B2	6S	10
Binford	Shallow to Gravel B1	6E	6G
2291:			
Great Bend	Loamy and Silty A1	2E	3
Zell	Thin Upland A2	3E	8
2292:			
Hamerly	Limy Subirrigated A5	2E	1K
Barnes	Loamy and Silty A1	2C	3
2293:			
Lamoure	Limy Subirrigated A5 (Wet C1)	6W	10
Colvin	Limy Subirrigated A5 (Wet C1)	6W	10
2324:			
Wyndmere	Limy Subirrigated A5	2E	1K
Tiffany	Overflow and Runon A3	2C	1

Table 10.—Windbreak Suitability Groups

Expected Shrub Heights At 20 Years

(Dashes (—) indicate the species are not expected to perform adequately on these suitability groups under most conditions.)

Species	Windbreak Suitability Groups					
	1	1K	2	2K	2H	3
	ft.	ft.	ft.	ft.	ft.	ft.
Almond, Russian	4-6	3-4	3-5	3-4	—	4-6
Buffaloberry, Silver	8-12	8-12	—	—	—	9-12
Caragana (Peashrub, Siberian)	8-10	8-10	7-8	—	—	8-10
Cherry, Europian Bird (Mayday)	10-15	—	10-15	—	—	10-12
Cherry, Nanking	6-8	—	4-6	—	—	5-7
Cherry, Mongolian	5-6	—	4-6	—	—	4-6
Cherry, Western Sand	4-6	—	—	—	—	4-6
Cotoneaster, Peking	8-10	7-9	8-10	—	—	7-9
Cotoneaster, Europian	10-12	9-11	8-12	—	—	7-9
Currant, Golden	5-7	—	4-6	—	—	5-6
Dogwood, Redosier	6-8	—	6-8	—	—	5-7
Forsythia, 'Meadowlark'	7-11	6-8	—	—	—	7-9
Honeysuckle, Amur	8-10	7-9	—	—	—	7-9
Honeysuckle, Blueleaf 'Freedom'	7-9	6-8	—	—	—	6-8
Honeysuckle, Tatarian	8-10	7-9	—	—	—	8-10
Indigo, False	7-9	6-8	7-9	7-9	—	5-7
Juneberry (Serviceberry)	6-8	—	5-7	—	—	5-7
Lilac, Common	10-12	10-12	8-10	8-10	—	8-10
Lilac, Late	10-12	8-10	10-12	8-10	—	8-10
Plum, American	7-9	—	6-7	—	—	7-9
Rose, Species	4-5	4-5	4-5	—	—	4-5
Sea-buckthorn	8-10	8-10	—	—	—	6-8
Silverberry	6-8	5-6	—	—	—	5-7
Sumac, Skunkbush	5-9	4-7	5-8	—	—	5-9
Willow, Sandbar	7-9	6-8	7-10	6-8	—	6-8
Viburnum, Nannyberry	12-16	—	12-14	—	—	10-12

Table 10.—Windbreak Suitability Groups--Continued

Expected Shrub Heights At 20 Years

(Dashes (—) indicate the species are not expected to perform adequately on these suitability groups under most conditions.)

Species	Windbreak Suitability Groups					
	4	4C	5	6D	6G	7
	ft.	ft.	ft.	ft.	ft.	ft.
Almond, Russian	4-5	4-5	3-4	—	—	—
Buffaloberry, Silver	7-8	7-8	4-7	4-6	4-6	—
Caragana (Peashrub, Siberian)	7-8	5-6	7-9	6-8	6-8	—
Cherry, Europian Bird (Mayday)	10-12	8-10	8-10	6-8	4-6	—
Cherry, Nanking	4-5	4-5	4-5	—	—	—
Cherry, Mongolian	4-6	4-6	4-5	—	—	—
Cherry, Western Sand	—	—	4-6	3-5	3-5	—
Cotoneaster, Peking	6-7	5-7	6-7	—	—	—
Cotoneaster, Europian	9-10	8-9	8-10	—	—	—
Currant, Golden	3-5	3-5	5-6	—	—	—
Dogwood, Redosier	4-6	4-6	—	—	—	—
Forsythia, 'Meadowlark'	—	—	6-8	—	—	—
Honeysuckle, Amur	7-9	7-9	6-8	—	—	—
Honeysuckle, Blueleaf 'Freedom'	6-8	6-8	5-7	4-6	4-6	—
Honeysuckle, Tatarian	7-8	7-8	6-7	5-7	5-7	—
Indigo, False	—	—	—	—	—	—
Juneberry (Serviceberry)	5-6	5-6	—	—	—	—
Lilac, Common	6-8	5-7	7-9	5-7	5-7	—
Lilac, Late	7-9	7-9	—	—	—	—
Plum, American	6-8	6-8	5-7	—	—	—
Rose, Species	4-5	3-4	3-4	2-4	2-4	—
Sea-buckthorn	6-8	6-8	5-7	4-6	4-6	—
Silverberry	—	—	5-7	4-6	4-6	—
Sumac, Skunkbush	4-7	4-7	5-9	6-7	6-7	—
Willow, Sandbar	5-6	5-6	—	—	—	—
Viburnum, Nannyberry	—	—	8-10	—	—	—

Table 10.—Windbreak Suitability Groups--Continued

Expected Shrub Heights At 20 Years

(Dashes (—) indicate the species are not expected to perform adequately on these suitability groups under most conditions.)

Species	Windbreak Suitability Groups				
	8	9C	9W	9L	10
	ft.	ft.	ft.	ft.	ft.
Almond, Russian	—	—	—	—	—
Buffaloberry, Silver	4-5	4-5	—	4-5	—
Caragana (Peashrub, Siberian)	4-5	4-5	—	4-5	6-8
Cherry, Europian Bird (Mayday)	—	—	—	—	4-6
Cherry, Nanking	—	—	—	—	—
Cherry, Mongolian	—	—	—	—	—
Cherry, Western Sand	—	—	—	—	3-5
Cotoneaster, Peking	—	—	—	—	—
Cotoneaster, Europian	—	—	—	—	—
Currant, Golden	—	3-4	3-4	3-4	—
Dogwood, Redosier	—	—	—	—	—
Forsythia, 'Meadowlark'	—	—	—	—	—
Honeysuckle, Amur	—	—	—	—	—
Honeysuckle, Blueleaf 'Freedom'	4-5	4-5	—	4-5	4-6
Honeysuckle, Tatarian	5-6	5-6	—	5-6	5-7
Indigo, False	—	—	—	—	—
Juneberry, (Serviceberry)	—	—	—	—	—
Lilac, Common	5-6	5-6	—	5-6	—
Lilac, Late	—	—	—	—	—
Plum, American	—	—	—	—	—
Rose, Species	—	—	—	—	2-4
Sea-buckthorn	4-5	4-5	—	4-5	4-6
Silverberry	3-5	3-5	—	3-5	4-6
Sumac, Skunkbush	3-4	3-4	—	3-4	6-7
Willow, Sandbar	—	—	—	—	—
Viburnum, Nannyberry	—	—	—	—	—

Table 10.—Windbreak Suitability Groups--Continued

Expected Deciduous Tree Heights At 20 Years

(Dashes (—) indicate the species are not expected to perform adequately on these suitability groups under most conditions.)

Species	Windbreak Suitability Groups					
	1	1K	2	2K	2H	3
	ft.	ft.	ft.	ft.	ft.	ft.
Apricot, Species	16-20	15-18	—	—	—	15-17
Ash, Black	20-24	17-20	19-22	17-20	—	18-22
Ash, Green	21-26	19-24	21-26	19-24	—	20-25
Aspen, Quaking	27-32	22-27	27-32	22-27	—	—
Boxelder	20-25	—	16-20	—	—	19-24
Chokecherry, Common	11-14	9-12	9-11	7-9	—	10-12
Cottonwood, Species	45-50	40-45	43-48	35-40	—	—
Crabapple, Species	18-20	—	17-20	—	—	17-19
Elm, Japanese	29-35	24-30	—	—	—	29-35
Elm, Siberian	28-35	28-35	28-32	28-35	—	26-32
Hackberry, Common	20-25	18-23	20-25	18-23	—	20-25
Hawthorn, Arnold	10-12	8-10	9-11	6-8	—	9-11
Hawthorn, Downy	10-12	8-10	9-11	6-8	—	9-11
Honeylocust	20-25	18-20	20-25	—	—	18-20
Maple, Amur	12-14	—	9-11	—	—	11-12
Maple, Tatarian	12-14	—	9-11	—	—	11-12
Oak, Bur	20-25	18-23	—	—	—	18-20
Olive, Russian	15-19	15-19	15-19	15-19	—	15-19
Pear, Ussurian(Harbin)	16-18	—	14-16	—	—	16-18
Poplar, Hybrid Species	50-55	—	45-50	—	—	—
Poplar, White	33-40	33-35	33-35	33-35	—	25-30
Walnut, Black	22-28	—	—	—	—	17-21
Willow, Laurel	30-35	20-25	30-35	20-25	20-25	—
Willow, White	30-35	20-25	30-35	20-25	20-25	—

Table 10.—Windbreak Suitability Groups--Continued

Expected Deciduous Tree Heights At 20 Years

(Dashes (—) indicate the species are not expected to perform adequately on these suitability groups under most conditions.)

Species	Windbreak Suitability Groups					
	4	4C	5	6D	6G	7
	ft.	ft.	ft.	ft.	ft.	ft.
Apricot, Species	—	—	—	—	—	—
Ash, Black	—	—	—	—	—	—
Ash, Green	18-20	18-20	15-19	14-18	14-18	—
Aspen, Quaking	—	—	—	—	—	—
Boxelder	—	—	—	—	—	—
Chokecherry, Common	8-10	7-9	8-10	7-9	7-9	—
Cottonwood, Species	—	—	—	—	—	—
Crabapple, Species	12-14	10-12	12-15	—	—	—
Elm, Japanese	26-30	26-30	26-30	19-22	19-22	—
Elm, Siberian	24-26	24-26	20-25	17-22	17-22	—
Hackberry, Common	16-18	16-18	15-18	—	—	—
Hawthorn, Arnold	7-9	7-9	8-10	6-8	6-8	—
Hawthorn, Downy	7-9	7-9	8-10	6-8	6-8	—
Honeylocust	—	—	15-18	—	—	—
Maple, Amur	—	—	—	—	—	—
Maple, Tatarian	—	—	—	—	—	—
Oak, Bur	14-16	13-15	18-20	—	—	—
Olive, Russian	12-14	12-14	12-15	11-14	11-14	—
Pear, Ussurian(Harbin)	11-13	11-13	11-13	—	—	—
Poplar, Hybrid Species	—	—	—	—	—	—
Poplar, White	—	—	—	—	—	—
Walnut, Black	—	—	—	—	—	—
Willow, Laurel	—	—	—	—	—	
Willow, White	—	—	—	—	—	—

Table 10.—Windbreak Suitability Groups--Continued

Expected Deciduous Tree Heights At 20 Years

(Dashes (—) indicate the species are not expected to perform adequately on these suitability groups under most conditions.)

Species	Windbreak Suitability Groups				
	8	9C	9W	9L	10
	ft.	ft.	ft.	ft.	ft.
Apricot, Species	—	—	—	—	—
Ash, Black	—	—	—	—	—
Ash, Green	12-16	9-11	9-10	9-13	—
Aspen, Quaking	—	—	—	—	—
Boxelder	—	—	—	—	—
Chokecherry, Common	—	—	—	—	—
Cottonwood, Species	—	—	—	—	—
Crabapple, Species	—	—	—	—	—
Elm, Japanese	19-21	11-15	—	11-15	—
Elm, Siberian	14-18	10-12	—	10-12	—
Hackberry, Common	—	—	—	—	—
Hawthorn, Arnold	—	—	—	—	—
Hawthorn, Downy	—	—	—	—	—
Honeylocust	—	—	—	—	—
Maple, Amur	—	—	—	—	—
Maple, Tatarian	—	—	—	—	—
Oak, Bur	—	—	—	—	—
Olive, Russian	11-14	6-8	6-8	8-10	—
Pear, Ussurian(Harbin)	—	8-9	—	—	—
Poplar, Hybrid Species	—	—	—	—	—
Poplar, White	—	—	—	—	—
Walnut, Black	—	—	—	—	—
Willow, Laurel	—	—	—	—	—
Willow, White	—	—	—	—	—

Table 10.—Windbreak Suitability Groups--Continued

Expected Conifer Heights At 20 Years

(Dashes (—) indicate the species are not expected to perform adequately on these suitability groups under most conditions.)

Species	Windbreak Suitability Groups					
	1	1K	2	2K	2H	3
	ft.	ft.	ft.	ft.	ft.	ft.
Arborvitae, Siberian	12-15	10-12	12-15	10-13	—	8-11
Juniper, Rocky Mountain	12-15	10-12	11-13	8-9	-	12-15
Larch, Siberian	18-22	-	-	-	-	17-21
Pine, Ponderosa	18-22	15-17	17-19	-	-	18-22
Pine, Scotch	18-20	-	16-18	-	-	18-20
Redcedar, Eastern	12-15	10-12	11-13	8-9	-	12-15
Spruce, Black Hills	17-20	-	15-18	-	-	12-15
Spruce, Colorado Blue	17-20	-	15-18	-	-	15-19
Spruce, White	17-20	-	15-18	-	-	15-19

Table 10.—Windbreak Suitability Groups--Continued

Expected Conifer Heights At 20 Years

(Dashes (—) indicate the species are not expected to perform adequately on these suitability groups under most conditions.)

Species	Windbreak Suitability Groups					
	4	4C	5	6D	6G	7
	ft.	ft.	ft.	ft.	ft.	ft.
Arborvitae, Siberian	7-10	7-10	—	—	—	—
Juniper, Rocky Mountain	10-12	10-12	11-13	9-11	9-11	7-9
Larch, Siberian	—	—	15-19	—	—	—
Pine, Ponderosa	16-17	16-17	16-20	11-16	11-16	11-15
Pine, Scotch	—	—	—	—	—	—
Redcedar, Eastern	10-12	10-12	11-13	9-11	9-11	8-10
Spruce, Black Hills	13-15	13-15	—	—	—	—
Spruce, Colorado Blue	13-15	13-15	—	—	—	—
Spruce, White	13-15	13-15	—	—	—	—
Redcedar, Eastern	7-9	6-7	5-6	6-7	—	
Spruce, Black Hills	—	—	—	—	—	
Spruce, Colorado Blue	—	—	—	—	—	
Spruce, White	—	—	—	—	—	

Table 10.—Windbreak Suitability Groups--Continued

Expected Conifer Heights At 20 Years

(Dashes (—) indicate the species are not expected to perform adequately on these suitability groups under most conditions.)

Species	Windbreak Suitability Groups				
	8	9C	9W	9L	10
	ft.	ft.	ft.	ft.	ft.
Arborvitae, Siberian	—	—	—	—	—
Juniper, Rocky Mountain	6-8	6-7	5-6	6-7	—
Larch, Siberian	—	—	—	—	—
Pine, Ponderosa	11-15	8-10	—	8-10	—
Pine, Scotch	—	—	—	—	—
Redcedar, Eastern	7-9	6-7	5-6	6-7	—
Spruce, Black Hills	—	—	—	—	—
Spruce, Colorado Blue	—	—	—	—	—
Spruce, White	—	—	—	—	—

Rangeland

Rangeland makes up about 20,000 acres or 3 percent of the land in Towner County. The majority of rangeland is on rolling to steep dissected till plains and associated wetlands. The soils are generally unsuited to poorly suited for cultivated crops. Rangeland is used primarily for grazing by domestic livestock; however, it also provides wildlife habitat, watershed protection, recreational areas, and aesthetic value.

Rangeland is defined as land on which the native vegetation (historic climax or natural potential plant community) is predominantly grasses, grasslike plants, forbs, and shrubs. Rangeland includes natural grasslands, savannas, marshes and wet meadows, most deserts, tundra, and alpine plant communities. Cultural treatments, such as fertilization and cultivation, generally are not used or needed to maintain productivity of rangeland. The composition and production of the plant community are largely determined by soil, climate, topography, and grazing influences.

Range Sites

In areas that have similar climate and topography, differences in the kind and amount of vegetation produced on rangeland are closely related to the kind of soil.

Soils vary in their capacity to produce grasses and other native plants. Soils that produce similar kinds, proportion, and amounts of vegetation are grouped into a range site.

Range site is a distinctive kind of rangeland which produces a characteristic natural plant community that differs from natural plant communities on other range sites in kind, amount, and proportion of rangeland plants. Over time, the combination of plants best suited to a particular soil and climate has become established. In the absence of excessive disturbances, this group of plants is the natural potential plant community or climax vegetation for the site. Natural plant communities are not static but vary slightly from year to year and place to place. The natural potential plant community is generally, but not always, the most productive and diverse combination of plants that may occur on a site.

The relationship between soils and vegetation was determined during this survey. In most cases, range sites can be determined directly from the soil map. Soil properties that affect moisture supply and plant nutrients have the greatest influence on the productivity of range sites. Soil reaction, salt content, and a seasonally high water table are also important. Many different range sites occur in the survey area. Range sites for each map unit component under undrained conditions are given in Table 11, “Range Sites.”

The following paragraphs describe soil and landscape features and limitations associated with the range sites in Major Land Resource Area (MLRA) 55A. Some of these range sites may not occur in Towner County.

Clayey range site. These are very deep, well and moderately well drained, moderately fine and fine textured soils. Permeability is slow or very slow. Available water capacity is high. This site is on nearly level to gently rolling glacial till plains, lake plains, and terraces of large streams. Slope ranges from 1 to 9 percent.

Depending on cause, site deterioration or retrogression results in a decrease in the abundance of such plants as western wheatgrass, porcupinegrass, green needlegrass, and prairie junegrass. The plants that usually increase under these conditions are needleandthread, blue grama, fringed sagewort, and upland sedges. Further deterioration may result in a dominance of blue grama, upland sedges, western ragweed, and fringed sagewort, and invasion of Kentucky bluegrass.

Very few problems affect management of this site. The water infiltration rate is slow. As a result, an adequate cover of vegetation is needed to help reduce runoff.

Claypan range site. These are very deep, moderately well and well drained soils. They have moderately coarse to moderately fine textured surface layers underlain by a sodic subsoil. The subsoils are moderately coarse to fine textured and

are high in sodium. Permeability is very slow and available water capacity is moderate. This site is on nearly level to undulating glacial till plains and lake plains. Slope ranges from 0 to 6 percent.

Site retrogression generally results in a decrease in the abundance of such plants as green needlegrass, prairie junegrass, needleandthread, and western wheatgrass. The plants that tend to increase in abundance under retrogression include inland saltgrass, blue grama, Sandberg bluegrass, upland sedges, and fringed sagewort. Further deterioration results in a dominance of blue grama, inland saltgrass, upland sedges, fringed sagewort, broom snakeweed, and annual forbs.

This site is easily damaged by mismanagement. Because of a dense subsoil and the content of salts in the soil, reestablishing the vegetation is difficult in denuded areas. Management that maintains an abundance of the climax species will maintain production and protect the soil from erosion.

Limy Subirrigated range site. These are very deep soils that are typically somewhat poorly drained, but include some moderately well drained soils. They have a loamy fine sand to silty clay loam surface layer and typically have a water table at about 1.5 to 3.5 feet during the spring and early summer. These soils have a layer high in lime within 16 inches of the surface. This site is on level, nearly level, and gently sloping glacial lake plains, glacial till plains, and outwash plains. Slope ranges from 0 to 6 percent.

Site deterioration usually results in a decrease in the abundance of big bluestem, indiangrass, switchgrass, and Maximilian sunflower. Little bluestem usually increases initially in abundance under these conditions, but it eventually decreases with more severe deterioration. Further deterioration results in a dominance of Baltic rush, common spikerush, annual grasses and forbs, and invasion of Kentucky bluegrass.

Generally, no major problems affect management. The dominant warm-season grasses on this site provide high-quality forage and wildlife habitat late in the growing season.

Overflow range site. These are very deep, moderately well and well drained, moderate to moderately fine textured soils that regularly receive additional run-on from surrounding uplands or flooding. Permeability is moderate and available water capacity is high to very high. This site occurs on nearly level swales and depressions in glacial till plains and on stream terraces and flood plains. Slope ranges from 0 to 3 percent.

Site retrogression results in a decrease in the abundance of big bluestem, green needlegrass, prairie dropseed, and switchgrass. The plants that increase in abundance under these conditions are western wheatgrass, blue grama, sun sedge, and fescue sedge. Further deterioration results in a dominance of blue grama and sedges, and invasion of Kentucky bluegrass.

As a result of flooding and the upland runoff received by this site, it is very productive when properly managed.

Saline Lowland range site. These are very deep, somewhat poorly and poorly drained, medium and fine textured saline soils. Also included are some saline-sodic soils. This range site receives additional water from groundwater seepage and/or run-on. Surface layers commonly are saline. Permeability is moderate to very slow and available water capacity is moderate. This site occurs on shallow basins and lake plains and on low terraces and bottomlands along streams. Slope ranges from 0 to 3 percent.

Site deterioration results in a decrease in the abundance of such plants as Nuttall alkaligrass, slender wheatgrass, and western wheatgrass. The plants that increase in abundance under these conditions are inland saltgrass, alkali muhly, foxtail barley, and mat muhly. Further deterioration results in a dominance of inland saltgrass, foxtail barley, silverweed cinquefoil, and western dock.

A high content of salts and a moderate available water capacity limit production on this site. Proper management of the adapted salt-tolerant plants will maintain optimum production. If the plant community has been severely damaged, however, the site recovers slowly. Wind and water erosion are hazards in denuded areas. Stockwater ponds on this site frequently contain salty water.

Sands range site. These are very deep, well or excessively drained, coarse textured soils. Permeability is rapid and available water capacity is low to moderate. Soils on this site are highly susceptible to wind erosion. This site is on nearly level to steep outwash and delta plains. Slope ranges from 1 to 35 percent.

Site deterioration generally results in a decrease in the abundance of such plants as prairie sandreed, little bluestem, sand bluestem, and leadplant amorpha. The plants that increase in abundance under these conditions are sand dropseed, blue grama, needleandthread, upland sedges, and forbs. Further deterioration results in a dominance of blue grama, upland sedges, annual forbs, fringed sagewort, green sagewort, cudweed sagewort, and prairie rose.

The limited available water capacity and the hazard of wind erosion are concerns in managing this site. In severely disturbed areas, blowouts are common. The vegetation responds rapidly to improved management.

Sandy range site. These are very deep, well drained, moderately coarse textured soils. Permeability is moderately rapid and available water capacity is moderate. These soils are friable and susceptible to wind erosion. This site is on nearly level to rolling glacial till plains, lake plains, and outwash plains. Slope ranges from 1 to 15 percent.

Site deterioration generally results in a decrease in the abundance of such plants as western wheatgrass, green needlegrass, prairie sandreed, and leadplant amorpha. The plants that increase under these conditions are needleandthread, blue grama, upland sedges, sand dropseed, and annual forbs. Further deterioration results in a dominance of blue grama, upland sedges, and forbs, such as western yarrow, green sagewort, and fringed sagewort.

Moderate available water capacity is a concern in managing this site. Also, wind erosion is a hazard in denuded areas. Management that maintains an abundance of the climax species results in a productive natural plant community and provides a good protective plant cover.

Sandy Claypan range site. These are very deep, somewhat poorly drained soils. They have moderately coarse textured surface layers underlain by a sodic subsoil. The subsoils are moderately coarse to medium textured and are high in sodium. Permeability is very slow and available water capacity is low. This site is on nearly level outwash and lake plains. Slope ranges from 0 to 3 percent.

Site deterioration results in a decrease in the abundance of such plants as western wheatgrass and needleandthread. The plants that increase in abundance under these conditions are blue grama, upland sedges, and fringed sagewort. Further deterioration results in a dominance of blue grama, upland sedges, fringed sagewort, annual forbs, and annual grasses.

The soils have a dense, sodic subsoil and a limited available water capacity. The site is fragile, and the natural plant community can deteriorate rapidly. Management that maintains a protective plant cover will control erosion.

Shallow to Gravel range site. These are shallow, moderately coarse and medium textured soils overlying sand and gravel at about 20 inches. They are somewhat excessively drained. Permeability is moderate over moderately rapid and available water capacity is low. This site occurs on nearly level to steep outwash plains and stream terraces. Slope ranges from 1 to 25 percent.

Site deterioration results in a decrease in the abundance of such plants as green needlegrass, western wheatgrass, plains muhly, and prairie junegrass. The plants that increase in abundance under these conditions are blue grama, red threeawn, and upland sedges. Further deterioration results in a dominance of blue grama, upland sedges, annual forbs, fringed sagewort, and clubmoss.

Low available water capacity limits production on this site. The site is fragile, and the plant community can deteriorate rapidly. The plant community should be kept near its potential, and maintained in a high state of vigor, in order to optimize use of available moisture.

Silty range site. These are moderately deep and very deep, well drained, medium and moderately fine textured soils. Permeability is moderate and available water capacity is high or very high. This site is on nearly level to steep glacial till plains, lake plains, and on high stream terraces. Slope ranges from 1 to 25 percent.

Site retrogression generally results in a decrease in the abundance of such plants as green needlegrass, prairie junegrass, western wheatgrass, and porcupinegrass. The plants that increase in abundance under these conditions are needleandthread, blue grama, threadleaf sedge, needleleaf sedge, and fringed sagewort. Further deterioration results in a dominance of blue grama, threadleaf sedge, needleleaf sedge, fringed sagewort, and other forbs. Kentucky bluegrass often invades as conditions deteriorate.

Generally, no major problems affect management of this site. In the more sloping areas, however, gullies can form in denuded areas.

Subirrigated range site. These are very deep, somewhat poorly and poorly drained, moderately coarse to moderately fine textured soils. These soils have a high water table which keeps the rooting zone moist for most of the growing season. Permeability is moderate to moderately slow and available water capacity is high. This site is on flats and in depressions and drainageways on glacial till plains, lake plains, and outwash plains. Slope ranges from 0 to 3 percent.

Site deterioration results in a decrease in the abundance of such plants as big bluestem, switchgrass, prairie cordgrass, northern reedgrass, indiangrass, and little bluestem. The plants that increase in abundance under these conditions are mat muhly, fowl bluegrass, Baltic rush, common

spikerush, and various forbs. Further deterioration results in a dominance of Kentucky bluegrass, other short grasses, grasslike plants, and forbs.

The high percentage of warm-season species on this site can provide high quality forage and wildlife habitat late in the growing season.

Subirrigated Sands range site. These are very deep, somewhat poorly drained, coarse textured soils. Permeability of these soils is rapid and available water capacity is low. This site occurs on nearly level or undulating delta plains. Slope ranges from 0 to 6 percent.

Site retrogression results in a decrease in the abundance of such plants as big bluestem, switchgrass, porcupinegrass, and Maximilian sunflower. The plants that increase in abundance under these conditions are sedges, undesirable forbs, and quaking aspen. Kentucky bluegrass is a common invader on this site. When the canopy of quaking aspen approaches 100 percent, the understory is dominated by sedges and shrubs.

The high percentage of warm-season species on this site can provide high-quality forage and wildlife habitat late in the growing season. The combination of grasses, sedges, forbs, shrubs, and trees provides a diversity of wildlife habitat and lends variety and fall color to the landscape. Because of the wide variation in canopy cover, individual areas of this site may vary widely. Wind erosion is a concern. It can be controlled by maintaining or reestablishing the climax grasses.

Thin Claypan range site. These are very deep, somewhat poorly to moderately well drained soils. The surface layer is thin, moderately coarse to moderately fine textured, and underlain by a dense sodic subsoil. The subsoils are moderately coarse to fine textured and high in sodium. Permeability is very slow and available water capacity is low to moderate. This site is on nearly level to rolling glacial till plains and lake plains. Slope ranges from 0 to 9 percent.

Site deterioration usually results in a decrease in the abundance of such plants as western wheatgrass, prairie junegrass, and needleandthread. Plants that increase in abundance under these conditions are blue grama, inland saltgrass, Sandberg bluegrass, and alkali muhly. Further deterioration results in a dominance of short grasses, sedges, fringed sagewort, broom snakeweed, and other forbs.

Because of the dense subsoil and high content of subsoil salts, productivity is quite low on this site. Ponds constructed on this site are likely to be salty.

Thin Sands range site. These are very deep, excessively drained, coarse textured soils that have a thin surface horizon. Permeability is rapid and available water capacity is low or very low. These soils are highly susceptible to wind erosion and require careful management. This site is on nearly level to very steep glacial outwash plains and wind-worked delta plains. Slope ranges from 1 to 50 percent.

Site deterioration results in a decrease in the abundance of such plants as prairie sandreed, prairie junegrass, little bluestem, sideoats grama, and sand bluestem. The plants that increase in abundance under these conditions are sand dropseed and upland sedges. Further deterioration results in a dominance of upland sedges, blue grama, and various forbs, and invasion of Kentucky bluegrass.

This site is very fragile. It is subject to wind erosion if the vegetation is damaged by overgrazing or the soil is denuded. Blowouts are common in disturbed areas. Proper management will maintain protective cover and optimum production.

Thin Upland range site. These very deep, well drained, medium and moderately fine textured soils have a thin surface horizon. Permeability is moderately slow and available water capacity is high. This site is on gently sloping to very steep glacial till uplands. Slope ranges from 3 to 50 percent.

Site retrogression results in a decrease in the abundance of such plants as little bluestem, needleandthread, and sideoats grama. The plants that increase in abundance under these conditions are blue grama, red threeawn, upland sedges, and various forbs. Further deterioration results in a dominance of blue grama, upland sedges, and fringed sagewort.

Generally, no major problems affect management of this site. Wind and water erosion are a problem in denuded areas. In the more sloping areas, however, gullies can form along trails.

Very Shallow range site. These are very shallow soils over sand and gravel. They are moderately coarse to medium textured soils underlain by sand and gravel at about 10 inches. They are excessively drained. Permeability is rapid and available water capacity is very low. This site is on nearly level to steep outwash plains and terraces. Slopes range from 1 to 35 percent.

Site deterioration results in a decrease in the abundance of such plants as needleandthread, western wheatgrass, sideoats grama, and plains muhly. The plants that increase in abundance under

these conditions are blue grama, red threeawn, sand dropseed and upland sedges. Further deterioration results in a dominance of blue grama, red threeawn, upland sedges, and various forbs and shrubs.

Available water capacity is very low on this site. Water erosion is a hazard in the more sloping areas. Gullies can form along trails and in denuded areas. Productivity can be maintained by proper management of the dominant mid-grasses.

Wet Meadow range site. These are very deep, poorly drained, medium and fine textured soils that are briefly flooded in the spring and summer. The soils dry at the surface by mid-summer but have water in the root zone. This site occurs in swales and depressions on glacial till plains, glacial lake plains, and outwash channels. The site normally receives additional water from surface runoff and/or underground seepage. Slopes are 0 to 3 percent.

Site retrogression results in a decrease in the abundance of slim sedge, wooly sedge, northern reedgrass, prairie cordgrass, and switchgrass. The plants that increase in abundance under these conditions are fescue sedge, common spikerush, Baltic rush, mat muhly, and fowl bluegrass. Further deterioration results in a dominance of low-growing sedges, short grasses, western dock, and Canada thistle.

This site is easily damaged when it is wet. Grazing during wet periods results in compaction, trampling, and root shearing. The site also is an excellent source of high quality prairie hay.

Wetland range site. These are very deep, very poorly drained soils. Soil texture has little affect as to the kind of vegetation on the site. Water stands over the surface for a major part of the growing season. Permeability of these soils is slow and available water capacity is high. This site is in depressions in glacial till plains, lake basins, and outwash channels. This site normally receives additional amounts of water from surface run-on and/or underground seepage. Slope is commonly less than 1 percent.

Site deterioration results in a decrease in the abundance of such plants as rivergrass, slough sedge, prairie cordgrass, and northern reedgrass. The plants that increase in abundance under these conditions are slim sedge, Baltic rush, common spikesedge, and American sloughgrass. Further deterioration results in a dominance of Baltic rush, common spikesedge, and Mexican dock.

This site is easily damaged when it is wet. Grazing during wet periods results in soil compaction, trampling, and root shearing. Climax vegetation and the important wetland wildlife values are maintained under proper management.

Range Site Plant Community, Composition, and Production

Characteristic vegetation, species composition, total annual production, and stocking rates by condition class are shown in Table 12, “Range Site Descriptions.”

The **characteristic vegetation** consists of grasses, grasslikes, forbs, shrubs and trees that dominate the natural potential plant community on each range site. The plant species within these groups are listed by **common name**. Under **composition by weight**, the expected percentage of the total annual production is given for each major species and groups of minor species making up the characteristic vegetation.

The range site description helps interpret the ecological and utilitarian values of a given site, including grazing, wildlife habitat, watershed protection, recreation, and others.

Total annual production is the amount of vegetation that can be expected to grow annually on well managed rangeland, supporting the potential natural plant community. It includes all vegetation, whether or not palatable to grazing animals. It includes the current year’s herbaceous growth, as well as growth of leaves, twigs, and fruit of woody plants. It does not include the increase in stem diameter of trees and shrubs. Potential production depends on the kind of range site. Current production depends on the rangeland condition and the amount of moisture available to the plants during the growing season. Production is expressed in pounds per acre of air-dry herbage for **favorable**, **average**, and **unfavorable** years, as determined by the amount and distribution of precipitation and the temperatures favorable to growing conditions.

Stocking Rates are based on production and expressed as **animal unit months** per acre for **excellent**, **good**, **fair**, and **poor** range condition classes. Animal Unit Month (AUM) is the amount of forage required monthly by an animal unit, generally described as one mature cow and calf up to 6 months old.

Range Condition

Range condition indicates the present composition of the plant community on a range site in relation to the climax vegetation. Range condition is determined by comparing the present plant community with the natural potential plant community on a particular range site. The more closely the existing community resembles the potential community, the higher the

range condition. Range condition is an ecological rating only, not a forage value rating. Range condition is expressed as **excellent, good**, **fair**, or **poor**, depending on how closely the present plant community resembles the natural potential plant community. **Excellent** indicates that 76 to 100 percent of the present plant community is the same as the climax vegetation; **good**, 51 to 75 percent; **fair**, 26 to 50 percent; and **poor**, 25 percent or less.

In some cases the plant community found on a site may not look similar to the potential plant community described in Table 12. This is usually due to a lower condition class, reflecting past disturbances, or in some cases long-term exclusion from grazing or fire. Abnormal disturbances that change the natural plant community include prolonged overgrazing or season-long grazing, excessive or untimely burning, erosion, and plowing. Under these circumstances, some of the climax plants decrease in proportion while others increase. Also, plants which were not part of the original native plant community may invade the site. A very severe disturbance, such as plowing, can completely destroy the natural plant community, resulting in dominance of annuals or weedy perennials of a lower plant successional status. If the plant community has not deteriorated significantly, it eventually can return to a higher condition class under proper range management.

Range Management

Range management requires a knowledge of the kinds of soils and of the potential natural plant community. It also requires an evaluation of the present range condition and trend. The primary objective in range management is to manipulate grazing in such a manner that the plants growing on a site are similar in kind and amount to the potential natural plant community for that site. Such management generally results in the optimum production and diversity of vegetation, suppression of undesirable brush and weeds, conservation of water, and control of erosion. Sometimes, however, a range condition somewhat below the potential meets forage needs, provides wildlife habitat, and protects soil and water resources.

Ecologically sound range management maintains excellent or good range condition. Water is conserved, yields are optimized, and soils are protected. An important management concern is recognizing the changes in the plant community that take place gradually and that can be misinterpreted or overlooked. Growth encouraged by heavy rainfall, for example, may lead to the conclusion that the range is in good condition when actually the plant cover is weedy and the long-term trend is toward lower production. On the other hand, some rangeland that has been grazed closely for a short period may have a degraded appearance that temporarily obscures its quality and ability to recover rapidly.

Rangeland can recover from prolonged overgrazing or other disturbance, if the climax species have not been completely eliminated from the plant community. Generally an adequate population of climax plants remains to restore the rangeland to excellent condition through sound grazing management. In areas where the climax plant community has been severely disturbed or destroyed, range seeding can accelerate improvement in range condition. Seeding the proper climax species also can restore productive rangeland on areas of depleted or low quality cropland or pastureland. Brush suppression, water developments, fencing, and other mechanical practices may be needed to facilitate proper grazing management for range improvement on some rangeland. Proper grazing management is the key to maintaining or improving the productivity and diversity of rangeland.

For additional information about rangeland management, contact the local Natural Resources Conservation Service or Cooperative Extension Service office.

Table 11.—Range Sites

(Range sites are for undrained conditions.)

Map symbol and soil name	Range site name
118:	
Barnes	Silty
Buse	Thin Upland
120:	
Barnes	Silty
Buse	Thin Upland
154:	
Barnes	Silty
Svea	Overflow
167:	
Bearden	Limy Subirrigated
314:	
Buse	Thin Upland
Barnes	Silty
450:	
Colvin	Wet Meadow
511:	
Divide	Limy Subirrigated
553:	
Egeland	Sandy
Embden	Overflow
846:	
Great Bend	Silty
Overly	Overflow
871:	
Hamerly	Limy Subirrigated
Cresbard	Silty
883:	
Hamerly	Limy Subirrigated
Tonka	Wet Meadow
Parnell	Wetland
926:	
Hecla	Sands
966:	
Hegne	Saline Lowland
971:	
Hegne	Wet Meadow
Fargo	Wet Meadow
1221:	
Maddock	Sands
Hecla	Sands
1267:	
Marysland	Wet Meadow

Table 11.—Range Sites--Continued

(Range sites are for undrained conditions.)

Map symbol and soil name	Range site name
1426:	
Parnell	Wetland
1466:	
Pits, gravel and sand	—
1710:	
Southam	Wetland
1782:	
Swenoda	Sandy
1884:	
Vallers	Saline Lowland
Parnell	Wetland
1886:	
Hamerly	Saline Lowland
Vallers	Saline Lowland
1978:	
Water	—
2048:	
Wyndmere	Limy Subirrigated
2151:	
Binford	Shallow to Gravel
Coe	Very Shallow
2196:	
Bearden	Saline Lowland
Colvin	Saline Lowland
2208:	
Brantford	Shallow to Gravel
Coe	Very Shallow
2286:	
Aberdeen	Clayey
Bearden	Limy Subirrigated
2287:	
Bearden	Limy Subirrigated
Lindaas	Wet Meadow
2288:	
Brantford	Shallow to Gravel
Divide	Limy Subirrigated
2289:	
Buse	Thin Upland
Svea	Silty
Lamoure	Wet Meadow
2290:	
Coe	Very Shallow
Binford	Shallow to Gravel

Table 11.—Range Sites--Continued

(Range sites are for undrained conditions.)

Map symbol and soil name	Range site name
2291:	
Great Bend	Silty
Zell	Thin Upland
2292:	
Hamerly	Limy Subirrigated
Barnes	Silty
2293:	
Lamoure	Wet Meadow
Colvin	Wet Meadow
2324:	
Wyndmere	Limy Subirrigated
Tiffany	Overflow

Table 12.—Range Site Descriptions - Clayey

Characteristic Vegetation	Common Name	Plant Community	Composition By Weight (Percent)
Grasses and Grasslikes	Western Wheatgrass		25
(70% to 90% of Total)	Green Needlegrass		20
	Porcupinegrass		10
	Blue Grama		5
	Needleandthread		5
	Bearded Wheatgrass	*	
	Prairie Dropseed	*	
	Plains Reedgrass	*	15
	Prairie Junegrass	*	
	Other Perennial Grasses	*	
	Needleleaf Sedge	*	
	Threadleaf Sedge	*	5
	Other Sedges/Rushes	*	
Forbs	Cudweed Sagewort	*	
(5% to 15% of Total)	Fringed Sagewort	*	
	Goatsbeard	*	
	Prairie Coneflower	*	10
	Scarlet Globemallow	*	
	Silverleaf Scurfpea	*	
	Western Yarrow	*	
	Other Perennial Forbs	*	
Shrubs and Trees	Prairie Rose	*	
(5% to 15% of Total)	Western Snowberry	*	5
	Other Perennial Shrubs	*	

Total Annual Production (Excellent Condition)	
Climatic Condition	Pounds Per Acre (dry)
Favorable	2400 to 2700
Average	2000 to 2300
Unfavorable	1600 to 1900

Stocking Rates	
Condition Class	AUM Per Acres Per Year**
Excellent	0.68 to 0.90
Good	0.45 to 0.68
Fair	0.23 to 0.45
Poor	0.10 to 0.23

*Indicates the composition for species group
**Animal unit month (AUM) - Amount of forage required monthly by an animal unit

Table 12.—Range Site Descriptions-Continued - Claypan

		Plant Community	
Characteristic Vegetation	Common Name		Composition By Weight (Percent)
Grasses and Grasslikes (70% to 90% of Total)	Western Wheatgrass		30
	Blue Grama		15
	Green Needlegrass		10
	Needleandthread		10
	Porcupinegrass		5
	Prairie Junegrass		5
	Bearded Wheatgrass	*	
	Inland Saltgrass	*	5
	Other Perennial Grasses	*	
	Needleleaf Sedge	*	10
	Other Sedges/Rushes	*	
Forbs (5% to 15% of Total)	Fringed Sagewort	*	
	Rush Skeletonplant	*	
	Scarlet Globemallow	*	
	Silverleaf Scurfpea	*	5
	Western Yarrow	*	
	Wild Parsley	*	
	Other Perennial Forbs	*	
Shrubs and Trees (5% to 15% of Total)	Gardner Saltbush	*	
	Prairie Rose	*	5
	Pricklypear	*	
	Other Perennial Shrubs	*	

Total Annual Production (Excellent Condition)

Climatic Condition	Pounds Per Acre (dry)
Favorable	1800 to 2000
Average	1500 to 1750
Unfavorable	1300 to 1500

Stocking Rates

Condition Class	AUM Per Acres Per Year**
Excellent	0.53 to 0.70
Good	0.35 to 0.53
Fair	0.18 to 0.35
Poor	0.10 to 0.18

*Indicates the composition for species group

**Animal unit month (AUM) - Amount of forage required monthly by an animal unit

Table 12.—Range Site Descriptions-Continued - Limy Subirrigated

Characteristic Vegetation	Common Name	Plant Community	Composition By Weight (Percent)
Grasses and Grasslikes (85% to 95% of Total)	Little Bluestem		35
	Big Bluestem		15
	Indiangrass	*	
	Inland Saltgrass	*	
	Mat Muhly	*	20
	Nuttall Alkaligrass	*	
	Prairie Dropseed	*	
	Switchgrass	*	
	Green Needlegrass	*	
	Needleandthread	*	
	Slender Wheatgrass	*	10
	Western Wheatgrass	*	
	Other Perennial Grasses	*	
	Rushes	*	10
	Sedge Species	*	
Forbs (5% to 15% of Total)	American Licorice	*	
	Goldenrod Species	*	
	Maximilian Sunflower	*	10
	Stiff Sunflower	*	
	Other Perennial Forbs	*	
Shrubs and Trees (0% of Total)			

Total Annual Production (Excellent Condition)	
Climatic Condition	Pounds Per Acre (dry)
Favorable	3800 to 4200
Average	3300 to 3700
Unfavorable	2800 to 3200

Stocking Rates	
Condition Class	AUM Per Acres Per Year**
Excellent	1.13 to 1.50
Good	0.75 to 1.13
Fair	0.38 to 0.75
Poor	0.10 to 0.38

*Indicates the composition for species group

**Animal unit month (AUM) - Amount of forage required monthly by an animal unit

Table 12.—Range Site Descriptions-Continued - Overflow

		Plant Community	
Characteristic Vegetation	Common Name		Composition By Weight (Percent)
Grasses and Grasslikes	Big Bluestem		25
(80% to 95% of Total)	Green Needlegrass		10
	Bearded Wheatgrass		5
	Needleandthread		5
	Porcupinegrass		5
	Switchgrass		5
	Western Wheatgrass		5
	Canada Wildrye	*	
	Little Bluestem	*	
	Mat Muhly	*	15
	Northern Reedgrass	*	
	Sideoats Grama	*	
	Other Perennial Grasses	*	
	Fescue Sedge	*	
	Needleleaf Sedge	*	5
	Other Sedges/Rushes	*	
Forbs	Cudweed Sagewort	*	
(5% to 10% of Total)	Fringed Sagewort	*	
	Heath Aster	*	
	Maximilian Sunflower	*	10
	Silverleaf Scurfpea	*	
	Wild Blue Lettuce	*	
	Other Perennial Forbs	*	
Shrubs and Trees	Common Chokecherry	*	
(0% to 10% of Total)	Juneberry	*	
	Prairie Rose	*	10
	Western Snowberry	*	
	Other Perennial Forbs	*	

Total Annual Production (Excellent Condition)	
Climatic Condition	Pounds Per Acre (dry)
Favorable	3100 to 3500
Average	3300 to 3075
Unfavorable	2250 to 2650

Stocking Rates	
Condition Class	AUM Per Acres Per Year**
Excellent	0.90 to 1.20
Good	0.60 to 0.90
Fair	0.30 to 0.60
Poor	0.10 to 0.30

*Indicates the composition for species group
**Animal unit month (AUM) - Amount of forage required monthly by an animal unit

Table 12.—Range Site Descriptions-Continued - Saline Lowland

		Plant Community	
Characteristic Vegetation	Common Name		Composition By Weight (Percent)
Grasses and Grasslikes (85% to 95% of Total)	Western Wheatgrass		40
	Slender Wheatgrass		15
	Inland Saltgrass		10
	Nuttall Alkaligrass		10
	Foxtail Barley		5
	Alkali Cordgrass	*	
	Alkali Muhly	*	
	Mat Muhly	*	10
	Sandberg Bluegrass	*	
	Other Perennial Grasses	*	
	Prairie Bulrush	*	Trace
	Other Sedges/Rushes	*	
Forbs (5% to 15% of Total)	Alkali Plantain	*	
	Dock Species	*	10
	Silver Cinquefoil	*	
	Other Perennial Forbs	*	
Shrubs and Trees (0% of Total)	Pricklypear	*	Trace

Total Annual Production (Excellent Condition)	
Climatic Condition	Pounds Per Acre (dry)
Favorable	2900 to 3200
Average	2500 to 2800
Unfavorable	2100 to 2400

Stocking Rates	
Condition Class	AUM Per Acres Per Year**
Excellent	0.83 to 1.10
Good	0.55 to 0.83
Fair	0.28 to 0.55
Poor	0.10 to 0.28

*Indicates the composition for species group
**Animal unit month (AUM) - Amount of forage required monthly by an animal unit

Table 12.—Range Site Descriptions-Continued - Sands

		Plant Community	
Characteristic Vegetation	Common Name		Composition By Weight (Percent)
Grasses and Grasslikes	Prairie Sandreed		25
(75% to 95% of Total)	Needleandthread		15
	Blue Grama		5
	Porcupinegrass		5
	Sand Bluestem		5
	Western Wheatgrass		5
	Bearded Wheatgrass	*	
	Canada Wildrye	*	
	Green Needlegrass	*	
	Little Bluestem	*	15
	Prairie Junegrass	*	
	Sand Dropseed	*	
	Other Perennial Grasses	*	
	Sun Sedge	*	
	Threadleaf Sedge	*	10
	Other Sedges	*	
Forbs	Fringed Sagewort	*	
(5% to 15% of Total)	Green Sagewort	*	
	Hairy Goldaster	*	
	Purple Coneflower	*	10
	Purple Prairieclover	*	
	Silky Prairieclover	*	
	Stiff Goldenrod	*	
	Other Perennial Forbs	*	
Shrubs and Trees	Leadplant Amorpha	*	
(0% to 10% of Total)	Prairie Rose	*	5
	Other Perennial Shrubs	*	

Total Annual Production (Excellent Condition)	
Climatic Condition	Pounds Per Acre (dry)
Favorable	2800 to 3100
Average	2400 to 2700
Unfavorable	2000 to 2300

Stocking Rates	
Condition Class	AUM Per Acres Per Year**
Excellent	0.75 to 1.00
Good	0.50 to 0.75
Fair	0.25 to 0.50
Poor	0.10 to 0.25

*Indicates the composition for species group
**Animal unit month (AUM) - Amount of forage required monthly by an animal unit

Table 12.—Range Site Descriptions-Continued - Sandy

		Plant Community	
Characteristic Vegetation	Common Name		Composition By Weight (Percent)
Grasses and Grasslikes	Prairie Sandreed		20
(85% to 95% of Total)	Needleandthread		15
	Blue Grama		5
	Green Needlegrass		5
	Porcupinegrass		5
	Prairie Junegrass		5
	Western Wheatgrass		5
	Bearded Wheatgrass	*	
	Canada Wildrye	*	15
	Little Bluestem	*	
	Other Perennial Grasses	*	
	Sun Sedge	*	
	Threadleaf Sedge	*	10
	Other Sedges	*	
Forbs	Cudweed Sagewort	*	
(5% to 10% of Total)	Fringed Sagewort	*	
	Goatsbeard	*	
	Green Sagewort	*	10
	Heath Aster	*	
	Western Yarrow	*	
	Woolly Goldenrod	*	
	Other Perennial Forbs	*	
Shrubs and Trees	Leadplant Amorpha	*	
(0% to 5% of Total)	Prairie Rose	*	5
	Western Snowberry	*	
	Other Perennial Shrubs	*	

Total Annual Production (Excellent Condition)	
Climatic Condition	Pounds Per Acre (dry)
Favorable	2500 to 2900
Average	2175 to 2525
Unfavorable	1800 to 2150

Stocking Rates	
Condition Class	AUM Per Acres Per Year**
Excellent	0.75 to 1.00
Good	0.50 to 0.75
Fair	0.25 to 0.50
Poor	0.10 to 0.25

*Indicates the composition for species group

**Animal unit month (AUM) - Amount of forage required monthly by an animal unit

Table 12.—Range Site Descriptions-Continued - Sandy Claypan

		Plant Community	
Characteristic Vegetation	Common Name		Composition By Weight (Percent)
Grasses and Grasslikes	Western Wheatgrass		35
(70% to 95% of Total)	Blue Grama		20
	Needleandthread		20
	Prairie Junegrass	*	5
	Other Perennial Grasses	*	
	Sun Sedge	*	5
	Threadleaf Sedge	*	
Forbs	Fringed Sagewort	*	
(5% to 15% of Total)	Rush Skeletonplant	*	5
	Scarlet Globemallow	*	
	Other Perennial Forbs	*	
Shrubs and Trees	Pricklypear	*	
(0% to 15% of Total)	Silver Sagebrush	*	10
	Western Snowberry	*	

Total Annual Production (Excellent Condition)	
Climatic Condition	Pounds Per Acre (dry)
Favorable	1500 to 3000
Average	1500 to 2000
Unfavorable	500 to 1000

Stocking Rates	
Condition Class	AUM Per Acres Per Year**
Excellent	0.60 to 0.80
Good	0.40 to 0.60
Fair	0.20 to 0.40
Poor	0.10 to 0.20

*Indicates the composition for species group
**Animal unit month (AUM) - Amount of forage required monthly by an animal unit

Table 12.—Range Site Descriptions-Continued - Shallow to Gravel

		Plant Community	
Characteristic Vegetation	Common Name		Composition By Weight (Percent)
Grasses and Grasslikes (70% to 90% of Total)	Needleandthread		20
	Western Wheatgrass		15
	Blue Grama		10
	Green Needlegrass		10
	Plains Muhly		5
	Porcupinegrass		5
	Prairie Junegrass		5
	Bearded Wheatgrass	*	
	Red Threeawn	*	10
	Sand Dropseed	*	
	Other Perennial Grasses	*	
	Sun Sedge	*	
	Threadleaf Sedge	*	5
	Other Sedges	*	
Forbs (5% to 15% of Total)	Dotted Gayfeather	*	
	Fringed Sagewort	*	
	Hoods Phlox	*	
	Missouri Goldenrod	*	10
	Rush Skeletonplant	*	
	Scarlet Globemallow	*	
	Other Perennial Forbs	*	
Shrubs and Trees (5% to 15% of Total)	Prairie Rose	*	
	Western Snowberry	*	5
	Other Perennial Shrubs	*	

Total Annual Production (Excellent Condition)	
Climatic Condition	Pounds Per Acre (dry)
Favorable	1700 to 1900
Average	1450 to 1650
Unfavorable	1200 to 1400

Stocking Rates	
Condition Class	AUM Per Acres Per Year**
Excellent	0.45 to 0.60
Good	0.30 to 0.45
Fair	0.15 to 0.30
Poor	0.10 to 0.15

*Indicates the composition for species group
**Animal unit month (AUM) - Amount of forage required monthly by an animal unit

Table 12.—Range Site Descriptions-Continued - Silty

		Plant Community	
Characteristic Vegetation	Common Name		Composition By Weight (Percent)
Grasses and Grasslikes (70% to 90% of Total)	Green Needlegrass		20
	Needleandthread		15
	Porcupinegrass		15
	Western Wheatgrass		10
	Bearded Wheatgrass		5
	Blue Grama		5
	Big Bluestem	*	
	Plains Muhly	*	
	Prairie Dropseed	*	10
	Prairie Junegrass	*	
	Other Perennial Grasses	*	
	Needleleaf Sedge	*	
	Threadleaf Sedge	*	5
	Other Sedges	*	
Forbs (5% to 15% of Total)	Cudweed Sagewort	*	
	Fringed Sagewort	*	
	Heath Aster	*	
	Stiff Goldenrod	*	10
	Western Yarrow	*	
	Other Perennial Forbs	*	
Shrubs and Trees (5% to 15% of Total)	Leadplant Amorpha	*	
	Prairie Rose	*	
	Silverberry	*	5
	Western Snowberry	*	
	Other Perennial Shrubs	*	

Total Annual Production (Excellent Condition)

Climatic Condition	Pounds Per Acre (dry)
Favorable	2500 to 2800
Average	2150 to 2450
Unfavorable	1800 to 2100

Stocking Rates

Condition Class	AUM Per Acres Per Year**
Excellent	0.83 to 1.10
Good	0.55 to 0.83
Fair	0.28 to 0.55
Poor	0.10 to 0.28

*Indicates the composition for species group

**Animal unit month (AUM) - Amount of forage required monthly by an animal unit

Table 12.—Range Site Descriptions-Continued - Subirrigated

		Plant Community	
Characteristic Vegetation	Common Name		Composition By Weight (Percent)
Grasses and Grasslikes (80% to 95% of Total)	Big Bluestem		25
	Switchgrass		20
	Little Bluestem		10
	Indiangrass		5
	Prairie Cordgrass		5
	Western Wheatgrass		5
	Mat Muhly	*	
	Northern Reedgrass	*	
	Slender Wheatgrass	*	10
	Tall Dropseed	*	
	Other Perennial Grasses	*	
	Fescue Sedge	*	
	Slim Sedge	*	5
	Wooly Sedge	*	
	Baltic Rush	*	
	Common Spikerush	*	5
	Other Sedges/Rushes	*	
Forbs (5% to 15% of Total)	Canada Anemone	*	
	Heath Aster	*	
	Maximilian Sunflower	*	10
	Silverweed Cinquefoil	*	
	Other Perennial Forbs	*	
Shrubs and Trees (0% to 5% of Total)	Western Snowberry	*	
	Willow Species	*	Trace
	Other Perennial Shrubs	*	

Total Annual Production (Excellent Condition)	
Climatic Condition	Pounds Per Acre (dry)
Favorable	4000 to 4400
Average	3550 to 3950
Unfavorable	3100 to 3500

Stocking Rates	
Condition Class	AUM Per Acres Per Year**
Excellent	1.20 to 1.60
Good	0.80 to 1.20
Fair	0.40 to 0.80
Poor	0.10 to 0.40

*Indicates the composition for species group
**Animal unit month (AUM) - Amount of forage required monthly by an animal unit

Table 12.—Range Site Descriptions-Continued - Subirrigated Sands

		Plant Community	
Characteristic Vegetation	Common Name		Composition By Weight (Percent)
Grasses and Grasslikes (75% to 90% of Total)	Big Bluestem		15
	Switchgrass		15
	Indiangrass		5
	Porcupinegrass		5
	Prairie Cordgrass		5
	Bluejoint Reedgrass	*	
	Mat Muhly	*	5
	Other Perennial Grasses	*	
	Sedge Species	*	25
	Other Sedges/Rushes	*	
Forbs (5% to 10% of Total)	Cudweed Sagewort	*	
	Maximilian Sunflower	*	10
	Western Ragweed	*	
Shrubs and Trees (5% to 15% of Total)	Western Snowberry	*	
	Willow Species	*	10
	Spirea	*	
	Prairie Rose	*	
	Quaking Aspen		5

Total Annual Production (Excellent Condition)	
Climatic Condition	Pounds Per Acre (dry)
Favorable	3200 to 3700
Average	2600 to 3100
Unfavorable	2000 to 2500

Stocking Rates	
Condition Class	AUM Per Acres Per Year**
Excellent	0.83 to 1.10
Good	0.55 to 0.83
Fair	0.28 to 0.55
Poor	0.10 to 0.28

*Indicates the composition for species group
**Animal unit month (AUM) - Amount of forage required monthly by an animal unit

Table 12.—Range Site Descriptions-Continued - Thin Claypan

Characteristic Vegetation	Common Name	Plant Community	Composition By Weight (Percent)
Grasses and Grasslikes	Western Wheatgrass		50
(80% to 95% of Total)	Blue Grama		15
	Inland Saltgrass		5
	Prairie Junegrass		5
	Alkali Muhly	*	
	Needleandthread	*	
	Sandberg Bluegrass	*	5
	Tumblegrass	*	
	Other Perennial Grasses	*	
	Needleleaf Sedge	*	
	Sun Sedge	*	5
	Other Sedges	*	
Forbs	Bladderpod	*	
(5% to 15% of Total)	Fringed Sagewort	*	
	Lemon Scurfpea	*	
	Rush Skeletonplant	*	10
	Scarlet Globemallow	*	
	Western Yarrow	*	
	Other Perennial Forbs	*	
Shrubs and Trees	Gardner Saltbush	*	5
(0% to 5% of Total)	Other Perennial Shrubs	*	

Total Annual Production (Excellent Condition)	
Climatic Condition	Pounds Per Acre (dry)
Favorable	1000 to 1100
Average	800 to 900
Unfavorable	600 to 700

Stocking Rates	
Condition Class	AUM Per Acres Per Year**
Excellent	0.23 to 0.30
Good	0.15 to 0.23
Fair	0.08 to 0.15
Poor	0.05 to 0.08

*Indicates the composition for species group
**Animal unit month (AUM) - Amount of forage required monthly by an animal unit

Table 12.—Range Site Descriptions-Continued - Thin Sands

		Plant Community	
Characteristic Vegetation	Common Name		Composition By Weight (Percent)
Grasses and Grasslikes	Prairie Sandreed		20
(75% to 90% of Total)	Little Bluestem		15
	Sand Bluestem		15
	Sideoats Grama		10
	Prairie Junegrass		5
	Blue Grama	*	
	Canada Wildrye	*	
	Green Needlegrass	*	10
	Needleandthread	*	
	Sand Dropseed	*	
	Other Perennial Grasses	*	
	Needleleaf Sedge	*	
	Sun Sedge	*	5
	Other Sedges	*	
Forbs	Cudweed Sagewort	*	
(5% to 15% of Total)	Groundcherry	*	
	Lemon Scurfpea	*	
	Missouri Goldenrod	*	10
	Rigid Sunflower	*	
	Rush Skeletonplant	*	
	Silky Prairieclover	*	
	Other Perennial Forbs	*	
Shrubs and Trees	Bur Oak	*	
(5% to 10% of Total)	Chokecherry	*	10
	Leadplant Amorpha	*	
	Prairie Rose	*	
	Sand Cherry	*	
	Other Perennial Shrubs and Trees	*	

Total Annual Production (Excellent Condition)	
Climatic Condition	Pounds Per Acre (dry)
Favorable	1900 to 2150
Average	1600 to 1850
Unfavorable	1300 to 1500

Stocking Rates	
Condition Class	AUM Per Acres Per Year**
Excellent	0.53 to 0.70
Good	0.35 to 0.53
Fair	0.18 to 0.35
Poor	0.10 to 0.18

*Indicates the composition for species group
**Animal unit month (AUM) - Amount of forage required monthly by an animal unit

Table 12.—Range Site Descriptions-Continued - Thin Upland

		Plant Community	
Characteristic Vegetation	Common Name		Composition By Weight (Percent)
Grasses and Grasslikes	Needleandthread		15
(70% to 90% of Total)	Western Wheatgrass		15
	Porcupinegrass		10
	Blue Grama		5
	Green Needlegrass		5
	Little Bluestem		5
	Plains Muhly		5
	Sideoats Grama		5
	Prairie Dropseed	*	
	Prairie Junegrass	*	10
	Prairie Sandreed	*	
	Other Perennial Grasses	*	
	Threadleaf Sedge	*	5
	Other Sedges	*	
Forbs	Cudweed Sagewort	*	
(5% to 15% of Total)	Fringed Sagewort	*	
	Missouri Goldenrod	*	
	Pasqueflower	*	10
	Western Ragweed	*	
	Western Yarrow	*	
	Yellow Owlclover	*	
	Other Perennial Forbs	*	
Shrubs and Trees	Juneberry	*	
(5% to 15% of Total)	Leadplant Amorpha	*	
	Prairie Rose	*	10
	Silverberry	*	
	Western Snowberry	*	
	Other Perennial Shrubs	*	

Total Annual Production (Excellent Condition)	
Climatic Condition	Pounds Per Acre (dry)
Favorable	2200 to 2500
Average	1850 to 2150
Unfavorable	1500 to 1850

Stocking Rates	
Condition Class	AUM Per Acres Per Year**
Excellent	0.60 to 0.80
Good	0.40 to 0.60
Fair	0.20 to 0.40
Poor	0.10 to 0.20

*Indicates the composition for species group
**Animal unit month (AUM) - Amount of forage required monthly by an animal unit

Table 12.—Range Site Descriptions-Continued - Very Shallow

		Plant Community	
Characteristic Vegetation	Common Name		Composition By Weight (Percent)
Grasses and Grasslikes (70% to 90% of Total)	Needleandthread		25
	Blue Grama		10
	Western Wheatgrass		10
	Plains Muhly		5
	Prairie Junegrass		5
	Red Threeawn		5
	Bearded Wheatgrass	*	
	Prairie Dropseed	*	15
	Sand Dropseed	*	
	Other Perennial Grasses	*	
	Threadleaf Sedge	*	
	Sun Sedge	*	5
	Other Sedges	*	
Forbs (5% to 15% of Total)	Dotted Gayfeather	*	
	Fringed Sagewort	*	
	Green Sagewort	*	
	Purple Prairieclover	*	10
	Rush Skeletonplant	*	
	Western Yarrow	*	
	Other Perennial Forbs	*	
Shrubs and Trees (5% to 10% of Total)	Prairie Rose	*	
	Silverberry	*	10
	Other Perennial Shrubs	*	

Total Annual Production (Excellent Condition)	
Climatic Condition	Pounds Per Acre (dry)
Favorable	850 to 1000
Average	675 to 825
Unfavorable	500 to 650

Stocking Rates	
Condition Class	AUM Per Acres Per Year**
Excellent	0.23 to 0.30
Good	0.15 to 0.23
Fair	0.08 to 0.15
Poor	0.05 to 0.08

*Indicates the composition for species group
**Animal unit month (AUM) - Amount of forage required monthly by an animal unit

Table 12.—Range Site Descriptions-Continued - Wet Meadow

		Plant Community	
Characteristic Vegetation	Common Name		Composition By Weight (Percent)
Grasses and Grasslikes	Prairie Cordgrass		15
(85% to 95% of Total)	Switchgrass		10
	Northern Reedgrass		5
	Fowl Bluegrass	*	
	Mat Muhly	*	10
	Other Perennial Grasses	*	
	Fescue Sedge	*	
	Slim Sedge	*	45
	Wooly Sedge	*	
	Other Sedges	*	
	Baltic Rush	*	
	Common Spikerush	*	5
	Other Sedges	*	
Forbs	Dock	*	
(5% to 10% of Total)	Field Mint	*	
	Indian Hemp	*	
	Rydberg's Sunflower	*	10
	Tall Goldenrod	*	
	Tall White Aster	*	
	Other Perennial Forbs	*	
Shrubs and Trees	Willow Species	*	Trace
(0% to 5% of Total)	Other Perennial Shrubs	*	

Total Annual Production (Excellent Condition)	
Climatic Condition	Pounds Per Acre (dry)
Favorable	4100 to 4450
Average	3700 to 4000
Unfavorable	3300 to 3600

Stocking Rates	
Condition Class	AUM Per Acres Per Year**
Excellent	1.20 to 1.60
Good	0.80 to 1.20
Fair	0.40 to 0.80
Poor	0.10 to 0.40

*Indicates the composition for species group
**Animal unit month (AUM) - Amount of forage required monthly by an animal unit

Table 12.—Range Site Descriptions-Continued - Wetland

		Plant Community	
Characteristic Vegetation	Common Name		Composition By Weight (Percent)
Grasses and Grasslikes	Rivergrass		20
(85% to 95% of Total)	Prairie Cordgrass		10
	Reed Canarygrass		5
	American Mannagrass	*	
	American Sloughgrass	*	10
	Northern Reedgrass	*	
	Other Perennial Grasses	*	
	Baltic Rush	*	
	Common Spikerush	*	10
	Other Rushes	*	
	Beaked Sedge	*	30
	Slough Sedge	*	
	Slim Sedge	*	
	Wooly Sedge	*	10
	Other Sedges	*	
Forbs	Dock Species	*	
(5% to 10% of Total)	Longroot Smartweed	*	
	Waterparsnip	*	5
	Water Plantain	*	
	Other Perennial Forbs	*	
Shrubs and Trees	Willow Species	*	Trace
(0% to 5% of Total)	Other Perennial Shrubs	*	

Total Annual Production (Excellent Condition)	
Climatic Condition	Pounds Per Acre (dry)
Favorable	5800 to 6200
Average	5300 to 5750
Unfavorable	4800 to 5200

Stocking Rates	
Condition Class	AUM Per Acres Per Year**
Excellent	1.65 to 2.20
Good	1.10 to 1.65
Fair	0.55 to 1.10
Poor	0.10 to 0.55

*Indicates the composition for species group

**Animal unit month (AUM) - Amount of forage required monthly by an animal unit

Recreation

Public areas in the survey area provide opportunities for numerous recreational activities, including: fishing, hiking, bird-watching, and hunting. For information on other recreational activities within the survey area contact the North Dakota State Department of Parks and Recreation.

Soils in the survey area are rated in Table 13, "Recreational Development," according to limitations affecting their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are location and accessibility of the area, size and shape of the area and its scenic quality, ability of the soil to support vegetation, access to water, potential water impoundment sites, and either access to public sewer lines or the capacity of the soil to absorb septic tank effluent. Soils subject to flooding are limited, in varying degrees, for recreational uses by the duration of flooding and the season when it occurs. Onsite assessment of the height, duration, intensity, and frequency of flooding is essential in planning recreational facilities.

Camp areas are tracts of land used intensively as sites for tents, trailers, and campers and for outdoor activities that accompany such sites. These areas require site preparation, such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. Soils are rated on the basis of soil properties that influence ease of developing camp areas and performance of the areas after development. Also considered are soil properties that influence trafficability and promote the growth of vegetation after heavy use.

Picnic areas are natural or landscaped tracts of land subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. Soils are rated on the basis of soil properties influencing cost of shaping the site, trafficability, and growth of vegetation after development. The surface of picnic areas should absorb rainfall readily, remain firm under heavy foot traffic, and not be dusty when dry.

Playgrounds are areas used intensively for baseball, football, or similar activities. These areas require a nearly level soil that is free of stones and can withstand heavy foot traffic and maintain an adequate cover of vegetation. Soils are rated on the basis of soil properties influencing the cost of shaping the site, trafficability, and the growth of vegetation. Slope and stoniness are the main concerns in developing playgrounds. The surface of the playgrounds should absorb rainfall readily, remain firm under heavy foot traffic, and not be dusty when dry.

Paths and trails are areas used for hiking and horseback riding. The areas should require little or no cutting and filling during site preparation. Soils are rated on the basis of soil properties influencing trafficability and erodibility. Paths and trails should remain firm under foot traffic and not be dusty when dry.

Golf fairways are subject to heavy foot traffic and some light vehicular traffic. Cutting or filling may be required. The best soils for use as golf fairways are firm when wet, are not dusty when dry, and are not subject to prolonged flooding during the period of use. They have moderate slopes and no stones or boulders on the surface. The suitability of the soil for tees or greens is not considered in rating the soils.

Interpretative ratings in Table 13 help engineers, planners, and others understand how soil properties influence recreational uses. Ratings for proposed uses are given in terms of limitations. Only the most restrictive features are listed. Other features may limit a specific recreational use.

The degree of soil limitation is expressed as **slight, moderate,** or **severe**.

Slight means soil properties are generally favorable for the rated use. Limitations are minor and can be easily overcome. Good performance and low maintenance are expected.

Moderate means soil properties are moderately favorable for the rated use. Limitations can be overcome or modified by special planning, design, or maintenance. During some part of the year, the expected performance may be less desirable than soils rated slight.

Severe means soil properties are unfavorable for the rated use. Examples of limitations are slope, bedrock near the surface, flooding, and a seasonal high water table. These limitations generally require major soil reclamation, special design, or intensive maintenance. Overcoming the limitations generally is difficult and costly.

Information in Table 13, “Recreational Development,” can be supplemented by other information in this survey. For example, interpretations for dwellings without basements and for local roads and streets in Table 15, “Building Site Development,” and interpretations for septic tank absorption fields in Table 16, “Sanitary Facilities,” can supplement information obtained from Table 13.

Table 13.—Recreational Development

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Dashes indicate that the map unit component was not rated.)

Map symbol and soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
118:					
Barnes	Slight	Slight	Moderate: slope, small stones	Slight	Slight
Buse	Slight	Slight	Moderate: slope, small stones	Slight	Slight
120:					
Barnes	Slight	Slight	Severe: slope	Slight	Slight
Buse	Slight	Slight	Severe: slope	Slight	Slight
154:					
Barnes	Slight	Slight	Moderate: small stones	Slight	Slight
Svea	Slight	Slight	Moderate: small stones	Slight	Slight
167:					
Bearden	Moderate: wetness	Moderate: wetness, percs slowly	Moderate: wetness	Moderate: wetness	Moderate: wetness
314:					
Buse	Moderate: slope	Moderate: slope	Severe: slope	Slight	Moderate: slope
Barnes	Moderate: slope	Moderate: slope	Severe: slope	Slight	Moderate: slope
450:					
Colvin	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness
511:					
Divide	Moderate: wetness, percs slowly	Moderate: wetness, percs slowly	Moderate: wetness, percs slowly	Moderate: wetness	Moderate: wetness
553:					
Egeland	Slight	Slight	Slight	Slight	Slight
Embden	Slight	Slight	Slight	Slight	Slight
846:					
Great Bend	Slight	Slight	Slight	Slight	Slight
Overly	Slight	Slight	Slight	Slight	Slight
871:					
Hamerly	Moderate: wetness, percs slowly	Moderate: wetness, percs slowly	Moderate: wetness, percs slowly	Moderate: wetness	Moderate: wetness

Table 13.—Recreational Development--Continued

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Dashes indicate that the map unit component was not rated.)

Map symbol and soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
871:					
Cresbard	Severe: excess sodium	Severe: excess sodium	Severe: excess sodium	Slight	Severe: excess sodium
883:					
Hamerly	Moderate: wetness, percs slowly	Moderate: wetness, percs slowly	Moderate: wetness, percs slowly	Moderate: wetness	Moderate: wetness
Tonka	Severe: ponding	Severe: ponding	Severe: ponding	Severe: ponding	Severe: ponding
Parnell	Severe: ponding	Severe: ponding	Severe: ponding	Severe: ponding	Severe: ponding
926:					
Hecla	Moderate: too sandy	Moderate: too sandy	Moderate: too sandy	Moderate: too sandy	Moderate: droughty
966:					
Hegne	Severe: wetness, too clayey	Severe: wetness, too clayey, excess salt	Severe: too clayey, wetness, excess salt	Severe: wetness, too clayey	Severe: excess salt, wetness, too clayey
971:					
Hegne	Severe: wetness, too clayey	Severe: wetness, too clayey	Severe: too clayey, wetness	Severe: wetness, too clayey	Severe: wetness, too clayey
Fargo	Severe: wetness, too clayey	Severe: wetness, too clayey	Severe: too clayey, wetness	Severe: wetness, too clayey	Severe: wetness, too clayey
1221:					
Maddock	Moderate: too sandy	Moderate: too sandy	Moderate: slope, too sandy	Moderate: too sandy	Moderate: droughty
Hecla	Moderate: too sandy	Moderate: too sandy too sandy	Moderate: slope,	Moderate: too sandy	Moderate: droughty
1267:					
Marysland	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness
1426:					
Parnell	Severe: ponding	Severe: ponding	Severe: ponding	Severe: ponding	Severe: ponding
1466:					
Pits, gravel and sand	Severe: slope, small stones	Severe: slope, too sandy	Severe: slope, small stones slope	Severe: too sandy, slope	Severe: small stones, droughty,
1710:					
Southam	Severe: ponding	Severe: ponding	Severe: ponding	Severe: ponding	Severe: ponding

Table 13.—Recreational Development--Continued

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Dashes indicate that the map unit component was not rated.)

Map symbol and soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
1782:					
Swenoda	Slight	Slight	Moderate: slope	Slight	Slight
1884:					
Vallers	Severe: wetness, excess salt	Severe: wetness, excess salt	Severe: wetness, excess salt	Severe: wetness	Severe: excess salt, wetness
Parnell	Severe: ponding	Severe: ponding	Severe: ponding	Severe: ponding	Severe: ponding
1886:					
Hamerly	Severe: excess salt	Severe: excess salt	Severe: excess salt	Moderate: wetness	Severe: excess salt
Vallers	Severe: wetness, excess salt	Severe: wetness, excess salt	Severe: wetness, excess salt	Severe: wetness	Severe: excess salt, wetness
1978:					
Water	—	—	—	—	—
2048:					
Wyndmere	Moderate: wetness	Moderate: wetness	Moderate: wetness	Moderate: wetness	Moderate: wetness, droughty
2151:					
Binford	Slight	Slight	Moderate: slope	Slight	Moderate: droughty
Coe	Slight	Slight	Moderate: slope	Slight	Severe: droughty
2196:					
Bearden	Severe: excess salt	Severe: excess salt	Severe: excess salt	Moderate: wetness	Severe: excess salt
Colvin	Severe: wetness, excess salt	Severe: wetness, excess salt	Severe: wetness, excess salt	Severe: wetness	Severe: excess salt, wetness
2208:					
Brantford	Slight	Slight	Moderate: slope, small stones	Slight	Moderate: droughty
Coe	Slight	Slight	Moderate: slope	Slight	Severe: droughty
2286:					
Aberdeen	Severe: excess sodium	Severe: excess sodium	Severe: excess sodium	Slight	Severe: excess sodium
Bearden	Moderate: wetness	Moderate: wetness, percs slowly	Moderate: wetness	Moderate: wetness	Moderate: wetness

Table 13.—Recreational Development--Continued

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Dashes indicate that the map unit component was not rated.)

Map symbol and soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
2287:					
Bearden---	Moderate: wetness	Moderate: wetness, percs slowly	Moderate: wetness	Moderate: wetness	Moderate: wetness
Lindaas---	Severe: ponding	Severe: ponding	Severe: ponding	Severe: ponding	Severe: ponding
2288:					
Brantford---	Slight	Slight	Moderate: slope, small stones	Slight	Moderate: droughty
Divide---	Moderate: wetness, percs slowly	Moderate: wetness, percs slowly	Moderate: slope, wetness, percs slowly	Moderate: wetness	Moderate: wetness
2289:					
Buse---	Severe: slope	Severe: slope	Severe: slope	Moderate: slope	Severe: slope
Svea---	Severe: slope	Severe: slope	Severe: slope	Moderate: slope	Severe: slope
Lamoure---	Severe: flooding, wetness	Severe: wetness	Severe: wetness, flooding	Severe: wetness	Severe: wetness, flooding
2290:					
Coe---	Moderate: slope	Moderate: slope	Severe: slope	Slight	Severe: droughty
Binford---	Moderate: slope	Moderate: slope	Severe: slope	Slight	Moderate: droughty, slope
2291:					
Great Bend---	Slight	Slight	Moderate: slope	Slight	Slight
Zell---	Slight	Slight	Moderate: slope	Slight	Slight
2292:					
Hamerly---	Moderate: wetness, percs slowly	Moderate: wetness, percs slowly	Moderate: wetness, percs slowly	Moderate: wetness	Moderate: wetness
Barnes---	Slight	Slight	Moderate: small stones	Slight	Slight
2293:					
Lamoure---	Severe: flooding, wetness	Severe: wetness	Severe: wetness, flooding	Severe: wetness	Severe: wetness, flooding
Colvin---	Severe: flooding, wetness	Severe: wetness	Severe: wetness, flooding	Severe: wetness	Severe: wetness, flooding

Table 13.—Recreational Development--Continued

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Dashes indicate that the map unit component was not rated.)

Map symbol and soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
2324:					
Wyndmere--------	Moderate: wetness	Moderate: wetness	Moderate: wetness	Moderate: wetness	Moderate: wetness
Tiffany---------	Moderate: wetness, percs slowly	Moderate: wetness, percs slowly	Moderate: wetness, percs slowly	Moderate: wetness	Moderate: wetness

Wildlife Habitat

Soils affect the kind and amount of vegetation that is available to wildlife for food and cover. They also affect the construction of water impoundments. If food, cover, or water is missing, inadequate, or inaccessible, wildlife will be scarce or will not inhabit the area.

If the soils have potential for habitat development, wildlife habitat can be created or improved by planting appropriate vegetation, properly managing existing plant cover, and fostering the natural establishment of desirable plants.

Habitat for openland wildlife consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, and shrubs. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. Wildlife attracted to these areas include Hungarian partridge, pheasant, sharptail grouse, meadowlark, lark bunting, cottontail rabbit, and red fox.

Habitat for woodland wildlife consists of areas of hardwoods or conifers or a mixture of these and associated grasses, legumes, and wild herbaceous plants. The wildlife attracted to this habitat include thrushes, woodpeckers, owls, tree squirrels, porcupine, raccoon, and deer.

Habitat for wetland wildlife consists of open, marshy or swampy, shallow water areas that support water-tolerant plants. The wildlife attracted to this habitat include ducks, geese, herons, shore birds, muskrat, mink, and beaver.

Habitat for rangeland wildlife consists of areas of shrubs and wild herbaceous plants. The wildlife attracted to rangeland include deer, sharptailed grouse, western meadowlark, and David's sparrow.

On Table 14 "Wildlife Habitat," soils in the survey area are rated according to their potential for providing habitat for various kinds of wildlife. This information can be used in planning parks, wildlife refuges, nature study areas, and other developments for wildlife. It can also be used for selecting soils suitable for establishing, improving, or maintaining specific elements of wildlife habitat; and in determining the intensity of management needed for each element of the habitat.

The potential of the soil for wildlife habitat is rated **good, fair, poor** or **very poor**. A rating of **good** indicates the kind of habitat is easily established, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected. A rating of **fair** indicates the kind of wildlife habitat can be established, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of **poor** indicates limitations are severe for the designated kind of habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of **very poor** indicates restrictions for the element or kind of wildlife habitat are very severe and unsatisfactory results can be expected. Creating, improving, or maintaining habitat is impractical or impossible.

The elements of wildlife habitat shown on Table 14 are described in the following paragraphs.

Grain and seed crops are domestic grains and seed-producing herbaceous plants used by wildlife. Examples are wheat, rye, oats, corn and barley.

Grasses and legumes are domestic perennial grasses and herbaceous legumes planted for wildlife food and cover. Examples are bromegrass, intermediate wheatgrass, tall wheatgrass, clover, and alfalfa.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds, that provide food and cover for wildlife. Examples are bluestem, goldenrod, blue grama, switchgrass, Maximilian sunflower, and western wheatgrass.

The major soil properties affecting the growth of grain and forage crops and wild herbaceous plants are depth of the root zone, texture of the surface layer, the amount of water available to plants, wetness, salinity or sodicity, and flooding. The length of the growing season also is important.

Shrubs are bushy woody plants that produce fruit, buds, twigs, bark, and foliage. Soil properties and features that affect the growth of shrubs are depth of the rooting zone, available water capacity, salinity, and soil moisture. Examples of shrubs are common chokecherry, buffaloberry, snowberry, and juneberry.

Hardwood trees and woody understory produce nuts or other fruit, buds, catkins, twigs, bark, and foliage that wildlife eat. Examples are oak, poplar,

boxelder, green ash, willow, and American elm. Examples of fruit-producing shrubs that are suitable for planting on soils that have good potential for these plants are hawthorn, American plum, redosier dogwood, chokecherry, serviceberry, and silver buffaloberry.

Coniferous plants are cone-bearing trees, shrubs, or ground cover that provide habitat or supply food in the form of browse, seed, or fruitlike cones. Examples are pine, spruce, cedar, and juniper.

The major soil properties affecting the growth of hardwood and coniferous trees and shrubs are depth of root zone, the amount of water available to plants, and wetness.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites. Submerged or floating aquatic plants are excluded. Wetland plants produce food or cover for wetland wildlife. Examples of these plants are smartweed, sedges, bulrushes, white top, common reedgrass, saltgrass, prairie cordgrass and cattail.

The major soil properties affecting wetland plants are texture of the surface layer, wetness, acidity or alkalinity, and slope.

Shallow water areas have an average depth of less than 5 feet. They are useful as habitat for some wildlife species. They are naturally wet areas or are created by dams, levees, or water-control measures in marshes or streams. Examples are muskrat marshes, waterfowl feeding areas, wildlife watering developments, beaver ponds, and other wildlife ponds.

The major soil properties affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability.

Table 14.—Wildlife Habitat

(See text for definitions of "good," "fair," and "very poor." Dashes indicate the map unit component was not rated.)

Map symbol and soil name	Potential for habitat elements								Potential as habitat for —			
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
118:												
Barnes	Good	Good	Good	Good	Good	Fair	Poor	Very Poor	Good	Good	Very Poor	Fair
Buse	Fair	Good	Fair	—	—	Fair	Very Poor	Very Poor	Fair	—	Very Poor	Fair
120:												
Barnes	Fair	Good	Good	Good	Good	Fair	Poor	Very Poor	Good	Good	Very Poor	Fair
Buse	Fair	Good	Fair	—	—	Fair	Very Poor	Very Poor	Fair	—	Very Poor	Fair
154:												
Barnes	Good	Good	Good	Good	Good	Fair	Poor	Very Poor	Good	Good	Very Poor	Fair
Svea	Good	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor	Good
167:												
Bearden	Good	Good	Good	Good	Good	Fair	Fair	Fair	Good	Good	Fair	Fair
314:												
Buse	Poor	Fair	Fair	—	—	Fair	Very Poor	Very Poor	Fair	—	Very Poor	Fair
Barnes	Fair	Good	Good	Good	Good	Fair	Very Poor	Very Poor	Good	Good	Very Poor	Fair
450:												
Colvin	Poor	Fair	Fair	Fair	Fair	Fair	Good	Good	Poor	Fair	Good	Fair
511:												
Divide	Fair	Fair	Good	Good	Good	Fair	Fair	Very Poor	Fair	Good	Poor	Fair
553:												
Egeland	Fair	Good	Good	—	—	Fair	Very Poor	Very Poor	Good	—	Very Poor	Fair
Embden	Fair	Good	Good	Good	Good	Fair	Poor	Poor	Good	Good	Poor	Fair
846:												
Great Bend	Good	Good	Good	—	—	Fair	Very Poor	Very Poor	Good	—	Very Poor	Fair
Overly	Good	Good	Good	Good	Good	Fair	Poor	Poor	Good	Good	Poor	Fair
871:												
Hamerly	Good	Good	Good	Good	Good	Fair	Fair	Fair	Good	Good	Fair	Fair
Cresbard	Good	Fair	Good	Fair Poor	Very	Poor Poor	Very Poor	Very	Good Poor	Very Poor	Very	Good

Table 14.—Wildlife Habitat--Continued

(See text for definitions of "good," "fair," and "very poor." Dashes indicate the map unit component was not rated.)

	Potential for habitat elements						Potential as habitat for —					

Table 14.—Wildlife Habitat--Continued

(See text for definitions of "good," "fair," and "very poor." Dashes indicate the map unit component was not rated.)

Map symbol and soil name	Potential for habitat elements								Potential as habitat for —			
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
1978:												
Water	—	—	—	—	—	—	—	—	—	—	—	—
2048:												
Wyndmere	Fair	Good	Good	Good	Good	Fair	Fair	Poor	Good	Good	Poor	Fair
2151:												
Binford	Fair	Good	Fair	Fair	Fair	Poor	Very Poor	Very Poor	Fair	Fair	Very Poor	Poor
Coe	Poor	Poor	Fair	—	—	Poor	Very Poor	Very Poor	Poor	—	Very Poor	Fair
2196:												
Bearden	Fair	Fair	Poor	Poor	Poor	Fair	Fair	Fair	Fair	Poor	Fair	Poor
Colvin	Poor	Fair	Poor	Fair	Fair	Fair	Good	Good	Poor	Fair	Good	Poor
2208:												
Brantford	Fair	Fair	Good	Fair	Fair	Poor	Poor	Very Poor	Fair	Fair	Very Poor	Fair
Coe	Poor	Poor	Fair	—	—	Poor	Very Poor	Very Poor	Poor	—	Very Poor	Fair
2286:												
Aberdeen	Fair	Fair	Good	—	—	Poor	Very Poor	Very Poor	Fair	—	Very Poor	Fair
Bearden	Good	Good	Good	Good	Good	Fair	Fair	Fair	Good	Good	Fair	Fair
2287:												
Bearden	Good	Good	Good	Good	Good	Fair	Fair	Fair	Good	Good	Fair	Fair
Lindaas	Poor	Poor	Fair	Fair	Fair	Poor	Good	Good	Poor	Fair	Good	Fair
2288:												
Brantford	Fair	Fair	Good	Fair	Fair	Poor	Poor	Poor	Fair	Fair	Very Poor	Fair
Divide	Fair	Fair	Good	Good	Good	Fair	Fair	Very Poor	Fair	Good	Poor	Fair
2289:												
Buse	Very Poor	Very Poor	Fair	—	—	Fair	Very Poor	Very Poor	Poor	—	Very Poor	Fair
Svea	Poor	Poor	Fair	Fair	Fair	Fair	Very Poor	Very Poor	Poor	Fair	Very Poor	Fair
Lamoure	Very Poor	Poor	Fair	Good	Good	Fair	Fair	Fair	Poor	Good	Fair	Fair
2290:												
Coe	Very Poor	Poor	Fair	—	—	Poor	Very Poor	Very Poor	Poor	—	Very Poor	Fair
Binford	Fair	Good	Fair	Fair	Fair	Poor	Very Poor	Very Poor	Fair	Fair	Very Poor	Poor

Table 14.—Wildlife Habitat--Continued

(See text for definitions of "good," "fair," and "very poor." Dashes indicate the map unit component was not rated.)

Map symbol and soil name	Potential for habitat elements								Potential as habitat for —			
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
2291:												
Great Bend	Good	Good	Good	—	—	Fair	Very Poor	Very Poor	Good	—	Very Poor	Fair
Zell	Fair	Good	Good	—	—	Fair	Very Poor	Very Poor	Good	—	Very Poor	Fair
2292:												
Hamerly	Good	Good	Good	Good	Good	Fair	Fair	Fair	Good	Good	Fair	Fair
Barnes	Good	Good	Good	Good	Good	Fair	Poor	Very Poor	Good	Good	Very Poor	Fair
2293:												
Lamoure	Very Poor	Poor	Fair	Good	Good	Fair	Fair	Fair	Poor	Good	Fair	Fair
Colvin	Poor	Fair	Fair	—	—	Fair	Good	Good	Poor	—	Good	Fair
2324:												
Wyndmere	Fair	Good	Good	Good	Good	Fair	Fair	Poor	Good	Good	Poor	Fair
Tiffany	Good	Good	Good	—	—	Good	Fair	Fair	Good	—	Fair	Good

Engineering

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. Ratings are given for building site development, sanitary facilities, construction materials, and water management. The ratings are based on observed performance of the soils and on the estimated data and test data in the "Soil Properties" section.

Information in this section is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil within a depth of 5 or 6 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.

The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this section. Local ordinances and regulations should be considered in planning, in site selection, and in design.

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 or 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

This information can be used to evaluate the potential of areas for residential, commercial, industrial, and recreational uses; make preliminary estimates of construction conditions; evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; plan detailed on-site investigations of soils and geology; locate potential sources of gravel, sand, earthfill, and topsoil; plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

The information in the tables, along with the soil maps, the soil descriptions, and other data provided in this survey, can be used to make additional interpretations.

Some of the terms used in this soil survey have a special meaning in soil science and are defined in the "Glossary."

Building Site Development

Table 15, "Building Site Development," shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, local roads and streets, and lawns and landscaping. The limitations are considered **slight** if soil properties and site features generally are favorable for the indicated use and limitations are minor and easily overcome; **moderate** if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and **severe** if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves, utility lines, open ditches, and other purposes. The ratings are based on soil properties, site features, and observed performance of the soils. The ease of digging, filling, and compacting is affected by the depth

to bedrock, a cemented pan, or a very firm dense layer; stone content; soil texture; and slope. The time of the year that excavations can be made is affected by the depth to a seasonal high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and depth to the water table.

Dwellings and small commercial buildings are structures built on shallow foundations on undisturbed soil. The load limit is the same as that for single-family dwellings no higher than three stories. Ratings are made for small commercial buildings without basements, for dwellings with basements, and for dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, shrinking and swelling, and organic layers can cause the movement of footings. A high water table, depth to bedrock or to a cemented pan, large stones, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 or 6 feet are not considered.

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material; a base of gravel, crushed rock, or stabilized soil material; and a flexible or rigid surface. Cuts and fills generally are limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. Depth to bedrock or to a cemented pan, a high water table, flooding, large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell potential, potential for frost action, and depth to a high water table affect the traffic-supporting capacity.

Lawns and landscaping require soils on which turf and ornamental trees and shrubs can be established and maintained. The ratings are based on soil properties, site features, and observed performance of the soils. Soil reaction, a high water table, depth to bedrock or to a cemented pan, the availalbe water capacity in the upper 40 inches, and the content of salts, sodium, and sulfidic materials affect plant growth. Flooding, wetness, slope, stoniness, and the amount of sand, clay, or organic matter in the surface layer affect trafficability after vegetation is established.

Sanitary Facilities

Table 16, “Sanitary Facilities,” shows the degree and the kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. It also shows the suitability of the soils for use as a daily cover for landfill.

Soil properties are important in selecting sites for sanitary facilities and in identifying limiting soil properties and site features to be considered in planning, design, and installation. Soil limitation ratings of **slight, moderate,** or **severe** are given for septic tank absorption fields, sewage lagoons, and trench and area sanitary landfills. Soil suitability ratings of **good, fair,** and **poor** are given for daily cover for landfill.

A rating of **slight** or **good** indicates that the soils have no limitations or that the limitations can be easily overcome. Good performance and low maintenance can be expected. A rating of **moderate** or **fair** indicates that the limitations should be recognized but generally can be overcome by good management or special design. A rating of **severe** or **poor** indicates that overcoming the limitations is difficult or impractical. Increased maintenance may be required.

Septic tank absorption fields are areas in which subsurface systems of tile or perforated pipe distribute effluent from a septic tank into the natural soil. The centerline of the tile is assumed to be at a depth of 24 inches. Only the part of the soil between depths of 24 and 60 inches is considered in making the ratings. The soil properties and site features considered are those that affect the absorption of the effluent, those that affect the construction and maintenance of the system, and those that may affect public health.

The ratings are based on soil properties, site features, and observed performance of the soils. Permeability, a high water table, depth to bedrock or to a cemented pan, and flooding affect absorption of the effluent. Large stones and bedrock or a cemented pan interfere with installation.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to filter the effluent effectively. Many local ordinances require that this material be of a certain thickness.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted, relatively impervious soil material. Aerobic lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Relatively

impervious soil material for the lagoon floor and sides is desirable to minimize seepage and contamination of local ground water.

Table 16, "Sanitary Facilities," gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock or to a cemented pan, flooding, large stones, and content of organic matter.

Excessive seepage resulting from rapid permeability in the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope, bedrock, and cemented pans can cause construction problems, and large stones can hinder compaction of the lagoon floor.

Trench sanitary landfill is an area where solid waste is disposed of by placing refuse in successive layers in an excavated trench. The waste is spread, compacted, and covered daily with a thin layer of soil that is excavated from the trench. When the trench is full, a final cover of soil material at least 2 feet thick is placed over the landfill. Soil properties that influence the risk of pollution, the ease of excavation, trafficability, and revegetation are the major considerations in rating the soils.

Area sanitary landfill is an area where solid waste is disposed of by placing refuse in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil that is imported from a source away from the site. A final cover of soil at least 2 feet thick is placed over the completed landfill. Soil properties that influence trafficability, revegetation, and the risk of pollution are the main considerations in rating the soils for area sanitary landfills.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground-water pollution. The ratings in the table "Sanitary Facilities" are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock or to a cemented pan, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, soil reaction, and content of salts and sodium affect trench type landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

Daily cover for landfill is the soil material that is used to cover compacted solid waste in an area sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste. The suitability of a soil for use as cover is based on properties that affect workability and the ease of digging, moving, and spreading the material over the refuse daily during both wet and dry periods.

Soil texture, wetness, rock fragments, and slope affect the ease of removing and spreading the material during wet and dry periods. Loamy or silty soils that are free of large stones or excess gravel are the best cover for a landfill. Clayey soils are sticky or cloddy and are difficult to spread; sandy soils are subject to soil blowing.

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock, a cemented pan, or the water table to permit revegetation. The soil material used as final cover for a landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

Waste Management

Soil properties are important when organic waste is applied as fertilizer and wastewater is applied in irrigated areas. They also are important when the soil is used as a medium for the treatment and disposal of the organic waste and wastewater. Unfavorable soil properties can result in environmental damage.

The use of organic waste and wastewater as production resources results in energy and resource conservation and minimizes the problems associated with waste disposal. If disposal is the goal, applying a maximum amount of the organic waste or the wastewater to a minimal area holds costs to a minimum; however there is a potential for environmental damage. If reuse is the goal, a minimum amount of organic waste or wastewater should be applied to a maximum area resulting in unlikely environmental damage.

Interpretations developed for waste management may include ratings for manure- and food-processing waste, municipal sewage sludge, use of wastewater for irrigation, and treatment of wastewater by slow rate, overland flow, and rapid infiltration processes.

Specific information regarding waste management is available at the local office of the Natural Resources

Conservation Service or the Cooperative Extension Service.

Construction Materials

Table 17, “Construction Materials” gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated **good, fair,** or **poor** as a source of roadfill and topsoil. They are rated as a **probable** or **improbable** source of sand and gravel.

Roadfill is soil material that is excavated in one place and used in road embankments in another place. In the table “Construction Materials,” the soils are rated as a source of roadfill for low embankments, generally less than 6 feet high and less exacting in design than higher embankments.

The ratings are for the soil material below the surface layer to a depth of 5 or 6 feet. It is assumed that soil layers will be mixed during excavating and spreading. Many soils have layers of contrasting suitability within their profile. Table 19, “Engineering Index Properties,” provides detailed information about each soil layer. This information can help to determine the suitability of each layer for use as roadfill. The performance of soil after it is stabilized with lime or cement is not considered in the ratings.

The ratings are based on soil properties, site features, and observed performance of the soils. The thickness of suitable material is a major consideration. The ease of excavation is affected by large stones, a high water table, and slope. How well the soil performs in place after it has been compacted and drained is determined by its strength (as inferred from the engineering classification of the soil) and shrink-swell potential.

Soils rated **good** contain significant amounts of sand or gravel, or both. They have at least 5 feet of suitable material, a low shrink-swell potential, few cobbles and stones, and slopes of 15 percent or less. Depth to the water table is more than 3 feet. Soils rated **fair** are more than 35 percent silt- and clay-sized particles and have a plasticity index of less than 10. They have a moderate shrink-swell potential, slopes of 15 to 25 percent, or many stones. Depth to the water table is 1 to 3 feet. Soils rated **poor** have one or more of the following characteristics: a plasticity index of more than 10, a high shrink-swell potential, many stones, slopes of more than 25 percent, or a water table at a depth of less than 1 foot. They may have layers of suitable material, but the material is less than 3 feet thick.

Sand and gravel are natural aggregates suitable for commercial use with a minimum of processing. They are used in many kinds of construction. Specifications for each use vary widely. In Table 17, “Construction Materials,” only the probability of finding material in suitable quantity in or below the soil is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

The properties used to evaluate the soil as a source of sand or gravel are gradation of grain sizes (as indicated by the engineering classification of the soil), the thickness of suitable material, and the content of rock fragments. Kinds of rock, acidity, and stratification are given in the soil series descriptions. Gradation of grain sizes is given in the table on engineering index properties.

A soil rated as a probable source has a layer of clean sand or gravel or a layer of sand or gravel that is as much as 12 percent silty fines. This material must be at least 3 feet thick and less than 50 percent, by weight, large stones. All other soils are rated as an improbable source. Fragments of soft bedrock, such as shale and siltstone, are not considered to be sand and gravel.

Topsoil is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

Plant growth is affected by toxic material and by such properties as soil reaction, available water capacity, and fertility. The ease of excavating, loading, and spreading is affected by rock fragments, slope, a water table, soil texture, and thickness of suitable material. Reclamation of the borrow area is affected by slope, a water table, rock fragments, bedrock, and toxic material.

Soils rated **good** have friable, loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel, and have slopes of less than 8 percent. They are low in content of soluble salts, are naturally fertile or respond well to fertilizer, and are not so wet that excavation is difficult.

Soils rated **fair** are sandy soils, loamy soils that have a relatively high content of clay, soils that have only 20 to 40 inches of suitable material, soils that have an appreciable amount of gravel, stones, or soluble salts, or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated **poor** are very sandy or clayey, have less than 20 inches of suitable material, have a large amount of gravel, stones, or soluble salts, have slopes of more than 15 percent, or have a seasonal high water table at or near the surface.

The surface layer of most soils generally is preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and nutrients for plant growth.

Water Management

Table 18 , “Water Management,” gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas; embankments, dikes, and levees; and aquifer-fed excavated ponds. The limitations are considered **slight** if soil properties and site features generally are favorable for the indicated use and limitations are minor and are easily overcome; **moderate** if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and **severe** if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

This table also gives for each soil the restrictive features that affect drainage, irrigation, terraces and diversions, and grassed waterways.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability of the soil and the depth to fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

Embankments, dikes, and levees are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In Table 18, “Water Management,” the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even more than the height of the embankment can affect performance and safety of the embankment. Generally, deeper on-site investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders, organic matter, or salts or sodium. A high water table affects the amount of usable material. It also affects trafficability.

Aquifer-fed excavated ponds are pits or dugouts that extend to a ground-water aquifer or to a depth below a permanent water table. Excluded are ponds that are fed only by surface runoff and embankment ponds that impound water 3 feet or more above the original surface. Excavated ponds are affected by depth to a permanent water table, permeability of the aquifer, and quality of the water as inferred from the salinity of the soil. Depth to bedrock and the content of large stones affect the ease of excavation.

Drainage is the removal of excess surface and subsurface water from the soil. How easily and effectively the soil is drained depends on the depth to bedrock, to a cemented pan, or to other layers that affect the rate of water movement; permeability; depth to a high water table or depth of standing water if the soil is subject to ponding; slope; susceptibility to flooding; subsidence of organic layers; and the potential for frost action. Excavating and grading and the stability of ditchbanks are affected by depth to bedrock or to a cemented pan, large stones, slope, and the hazard of cutbanks caving. The productivity of the soil after drainage may be adversely affected by extreme acidity or by toxic substances in the root zone, such as salts, sodium, or sulfur. Availability of drainage outlets is not considered in the ratings.

Irrigation is the controlled application of water to supplement rainfall and support plant growth. The design and management of an irrigation system are affected by depth to the water table, the need for drainage, flooding, available water capacity, intake rate, permeability, erosion hazard, and slope. The construction of a system is affected by large stones and depth to bedrock or to a cemented pan. The performance of a system is affected by the depth of the root zone, the amount of salts or sodium, and soil reaction.

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to control erosion and conserve moisture by intercepting runoff.

Slope, wetness, large stones, and depth to bedrock or to a cemented pan affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of soil blowing or water erosion, an excessively coarse texture, and restricted permeability adversely affect maintenance.

Grassed waterways are natural or constructed channels, generally broad and shallow, that conduct surface water to outlets at a nonerosive velocity. Large

stones, wetness, slope, and depth to bedrock or to a cemented pan affect the construction of grassed waterways. A hazard of soil blowing, low available water capacity, restricted rooting depth, toxic substances such as salts or sodium, and restricted permeability may adversely affect the growth and maintenance of the grass after construction.

Table 15.—Building Site Development

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight,", "moderate," and "severe." The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation.)

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
118:						
Barnes	Slight	Moderate: shrink-swell	Moderate: shrink-swell	Moderate: shrink-swell, slope	Severe: low strength	Slight
Buse	Slight	Moderate: shrink-swell	Moderate: shrink-swell	Moderate: shrink-swell, slope	Severe: low strength	Slight
120:						
Barnes	Slight	Moderate: shrink-swell	Moderate: shrink-swell	Moderate: shrink-swell, slope	Severe: low strength	Slight
Buse	Slight	Moderate: shrink-swell	Moderate: shrink-swell	Moderate: shrink-swell, slope	Severe: low strength	Slight
154:						
Barnes	Slight	Moderate: shrink-swell	Moderate: shrink-swell	Moderate: shrink-swell	Severe: low strength	Slight
Svea	Moderate: wetness	Moderate: shrink-swell	Moderate: wetness, shrink-swell	Moderate: shrink-swell	Severe: low strength	Slight
167:						
Bearden	Severe: wetness	Moderate: wetness, shrink-swell	Severe: wetness, shrink-swell	Moderate: wetness, shrink-swell	Severe: low strength, frost action	Moderate: wetness
314:						
Buse	Moderate: slope	Moderate: shrink-swell, slope	Moderate: slope, shrink-swell	Severe: slope	Severe: low strength	Moderate: slope
Barnes	Moderate: slope	Moderate: shrink-swell, slope	Moderate: slope, shrink-swell	Severe: slope	Severe: low strength	Moderate: slope
450:						
Colvin	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness	Severe: low strength, wetness, frost action	Severe: wetness
511:						
Divide	Severe: cutbanks cave, wetness	Moderate: wetness	Severe: wetness	Moderate: wetness	Moderate: wetness, frost action	Moderate: wetness
553:						
Egeland	Severe: cutbanks cave	Slight	Slight	Slight	Moderate: frost action	Slight
Embden	Severe: cutbanks cave	Slight	Moderate: wetness	Slight	Moderate: frost action	Slight

Table 15.—Building Site Development--Continued

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight,", "moderate," and "severe." The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation.)

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
846:						
Great Bend-------	Severe: cutbanks cave	Moderate: shrink-swell	Moderate: shrink-swell	Moderate: shrink-swell	Severe: low strength, frost action	Slight
Overly-----------	Moderate: too clayey, wetness	Moderate: shrink-swell	Moderate: wetness, shrink-swell	Moderate: shrink-swell	Severe: low strength, frost action	Slight
871:						
Hamerly----------	Severe: wetness	Moderate: wetness, shrink-swell	Severe: wetness	Moderate: wetness, shrink-swell	Severe: frost action	Moderate: wetness
Cresbard---------	Moderate: too clayey, wetness	Severe: shrink-swell	Moderate: wetness, shrink-swell	Severe: shrink-swell	Severe: shrink-swell, low strength	Severe: excess sodium
883:						
Hamerly----------	Severe: wetness	Moderate: wetness, shrink-swell	Severe: wetness	Moderate: wetness, shrink-swell	Severe: frost action	Moderate: wetness
Tonka------------	Severe: ponding	Severe: ponding, shrink-swell	Severe: ponding, shrink-swell	Severe: ponding, shrink-swell	Severe: shrink-swell, low strength, ponding	Severe: ponding
Parnell----------	Severe: excess humus, ponding	Severe: ponding, shrink-swell	Severe: ponding, shrink-swell ponding	Severe: ponding, shrink-swell	Severe: shrink-swell, low strength,	Severe: ponding
926:						
Hecla------------	Severe: cutbanks cave	Slight	Moderate: wetness	Slight	Moderate: frost action	Moderate: droughty
966:						
Hegne------------	Severe: cutbanks cave, wetness	Severe: wetness, shrink-swell	Severe: wetness, shrink-swell	Severe: wetness, shrink-swell	Severe: shrink-swell, low strength, wetness	Severe: excess salt, wetness, too clayey
971:						
Hegne------------	Severe: cutbanks cave, wetness	Severe: wetness, shrink-swell	Severe: wetness, shrink-swell	Severe: wetness, shrink-swell	Severe: shrink-swell, low strength, wetness	Severe: wetness, too clayey
Fargo------------	Severe: cutbanks cave, wetness	Severe: wetness, shrink-swell	Severe: wetness, shrink-swell	Severe: wetness, shrink-swell	Severe: shrink-swell, low strength, wetness	Severe: wetness, too clayey

Table 15.—Building Site Development--Continued

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight,", "moderate," and "severe." The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation.)

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
1221:						
Maddock	Severe: cutbanks cave	Slight	Slight	Slight	Slight	Moderate: droughty
Hecla	Severe: cutbanks cave	Slight	Moderate: wetness	Slight	Moderate: frost action	Moderate: droughty
1267:						
Marysland	Severe: cutbanks cave, wetness	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness, frost action	Severe: wetness
1426:						
Parnell	Severe: excess humus, ponding	Severe: ponding, shrink-swell	Severe: ponding, shrink-swell	Severe: ponding, shrink-swell	Severe: shrink-swell, low strength, ponding	Severe: ponding
1466:						
Pits, gravel and sand	Severe: cutbanks cave, slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: small stones, droughty, slope
1710:						
Southam	Severe: ponding	Severe: ponding, shrink-swell	Severe: ponding, shrink-swell	Severe: ponding, shrink-swell	Severe: shrink-swell, low strength, ponding	Severe: ponding
1782:						
Swenoda	Moderate: wetness	Slight	Moderate: wetness, shrink-swell	Slight	Moderate: frost action	Slight
1884:						
Vallers	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness	Severe: low strength, wetness, frost action	Severe: excess salt, wetness
Parnell	Severe: excess humus, ponding	Severe: ponding, shrink-swell	Severe: ponding, shrink-swell	Severe: ponding, shrink-swell	Severe: shrink-swell, low strength, ponding	Severe: ponding
1886:						
Hamerly	Severe: wetness	Moderate: wetness, shrink-swell	Severe: wetness	Moderate: wetness, shrink-swell	Severe: low strength, frost action	Severe: excess salt
Vallers	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness	Severe: low strength, wetness, frost action	Severe: excess salt, wetness

Table 15.—Building Site Development--Continued

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight,", "moderate," and "severe." The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation.)

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
1978:						
Water	—	—	—	—	—	—
2048:						
Wyndmere	Severe: cutbanks cave, wetness	Moderate: wetness	Severe: wetness	Moderate: wetness	Severe: frost action droughty	Moderate: wetness,
2151:						
Binford	Severe: cutbanks cave	Slight	Slight	Slight	Slight	Moderate: droughty
Coe	Severe: cutbanks cave	Slight	Slight	Slight	Slight	Severe: droughty
2196:						
Bearden	Severe: wetness	Moderate: wetness, shrink-swell	Severe: wetness	Moderate: wetness, shrink-swell	Severe: low strength, frost action	Severe: excess salt
Colvin	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness	Severe: low strength, wetness	Severe: excess salt, wetness
2208:						
Brantford	Severe: cutbanks cave	Slight	Slight	Slight	Slight	Moderate: droughty
Coe	Severe: cutbanks cave	Slight	Slight	Slight	Slight	Severe: droughty
2286:						
Aberdeen	Severe: cutbanks cave	Severe: shrink-swell	Severe: shrink-swell	Severe: shrink-swell	Severe: shrink-swell, low strength	Severe: excess sodium
Bearden	Severe: wetness	Moderate: wetness, shrink-swell	Severe: wetness, shrink-swell	Moderate: wetness, shrink-swell	Severe: low strength, frost action	Moderate: wetness
2287:						
Bearden	Severe: wetness	Moderate: wetness, shrink-swell	Severe: wetness, shrink-swell	Moderate: wetness, shrink-swell	Severe: low strength, frost action	Moderate: wetness
Lindaas	Severe: ponding	Severe: ponding, shrink-swell	Severe: ponding	Severe: ponding, shrink-swell	Severe: shrink-swell, low strength, ponding	Severe: ponding
2288:						
Brantford	Severe: cutbanks cave	Slight	Slight	Slight	Slight	Moderate: droughty
Divide	Severe: cutbanks cave, wetness	Moderate: wetness	Severe: wetness	Moderate: wetness	Moderate: wetness, frost action	Moderate: wetness

Table 15.—Building Site Development--Continued

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight,", "moderate," and "severe." The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation.)

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
2289:						
Buse	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: low strength, slope	Severe: slope
Svea	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: low strength, slope	Severe: slope
Lamoure	Severe: wetness	Severe: flooding, wetness	Severe: flooding, wetness	Severe: flooding, wetness	Severe: low strength, wetness, flooding	Severe: wetness, flooding
2290:						
Coe	Severe: cutbanks cave	Moderate: slope	Moderate: slope	Severe: slope	Moderate: slope	Severe: droughty
Binford	Severe: cutbanks cave	Moderate: slope	Moderate: slope	Severe: slope	Moderate: slope	Moderate: droughty, slope
2291:						
Great Bend	Severe: cutbanks cave	Moderate: shrink-swell	Moderate: shrink-swell	Moderate: shrink-swell, slope	Severe: low strength, frost action	Slight
Zell	Slight	Slight	Slight	Moderate: slope	Severe: frost action	Slight
2292:						
Hamerly	Severe: wetness	Moderate: wetness, shrink-swell	Severe: wetness	Moderate: wetness, shrink-swell	Severe: frost action	Moderate: wetness
Barnes	Slight	Moderate: shrink-swell	Moderate: shrink-swell	Moderate: shrink-swell	Severe: low strength	Slight
2293:						
Lamoure	Severe: wetness	Severe: flooding, wetness	Severe: flooding, wetness	Severe: flooding, wetness	Severe: low strength, wetness, flooding	Severe: wetness, flooding
Colvin	Severe: wetness	Severe: flooding, wetness	Severe: flooding, wetness	Severe: flooding, wetness	Severe: low strength, wetness, flooding	Severe: wetness, flooding
2324:						
Wyndmere	Severe: cutbanks cave, wetness	Moderate: wetness	Severe: wetness	Moderate: wetness	Severe: frost action	Moderate: wetness
Tiffany	Severe: wetness	Moderate: wetness	Severe: wetness	Moderate: wetness	Severe: frost action	Moderate: wetness

Table 16.—Sanitary Facilities

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "good," and other terms. Dashes indicate the map unit component was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation.)

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
118:					
Barnes	Severe: percs slowly	Moderate: seepage, slope	Moderate: too clayey	Slight	Fair: too clayey
Buse	Severe: percs slowly	Moderate: seepage, slope	Moderate: too clayey	Slight	Fair: too clayey
120:					
Barnes	Severe: percs slowly	Severe: slope	Moderate: too clayey	Slight	Fair: too clayey
Buse	Severe: percs slowly	Severe: slope	Moderate: too clayey	Slight	Fair: too clayey
154:					
Barnes	Severe: percs slowly	Moderate: seepage	Moderate: too clayey	Slight	Fair: too clayey
Svea	Severe: wetness, percs slowly	Severe: wetness	Severe: wetness	Severe: wetness	Fair: too clayey, wetness
167:					
Bearden	Severe: wetness, percs slowly	Severe: wetness	Severe: wetness, too clayey	Severe: wetness	Poor: too clayey, hard to pack
314:					
Buse	Severe: percs slowly	Severe: slope	Moderate: slope, too clayey	Moderate: slope	Fair: too clayey, slope
Barnes	Severe: percs slowly	Severe: slope	Moderate: slope, too clayey	Moderate: slope	Fair: too clayey, slope
450:					
Colvin	Severe: wetness, percs slowly	Severe: wetness	Severe: wetness	Severe: wetness	Poor: wetness
511:					
Divide	Severe: wetness, poor filter	Severe: seepage, wetness	Severe: seepage, wetness, too sandy	Severe: seepage, wetness	Poor: seepage, too sandy, small stones
553:					
Egeland	Slight	Severe: seepage	Severe: seepage	Severe: seepage	Fair: too sandy
Embden	Severe: wetness	Severe: seepage, wetness	Severe: seepage, wetness	Severe: seepage, wetness	Fair: too sandy, wetness

Table 16.—Sanitary Facilities--Continued

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "good," and other terms. Dashes indicate the map unit component was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation.)

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
846:					
Great Bend	Severe: percs slowly	Moderate: seepage	Moderate: too clayey	Slight	Fair: too clayey
Overly	Severe: wetness, percs slowly	Severe: wetness	Severe: wetness	Severe: wetness	Poor: thin layer
871:					
Hamerly	Severe: wetness, percs slowly	Severe: wetness	Severe: wetness	Severe: wetness	Fair: too clayey, wetness
Cresbard	Severe: percs slowly	Moderate: wetness	Severe: wetness, excess sodium	Moderate: wetness	Poor: hard to pack, excess sodium
883:					
Hamerly	Severe: wetness, percs slowly	Severe: wetness	Severe: wetness	Severe: wetness	Fair: too clayey, wetness
Tonka	Severe: wetness, percs slowly	Severe: ponding	Severe: ponding, too clayey	Severe: ponding	Poor: too clayey, hard to pack, ponding
Parnell	Severe: ponding, percs slowly	Severe: ponding	Severe: ponding, too clayey	Severe: ponding	Poor: too clayey, hard to pack, ponding
926:					
Hecla	Severe: wetness, poor filter	Severe: seepage, wetness	Severe: seepage, wetness, too sandy	Severe: seepage, wetness	Poor: seepage, too sandy
966:					
Hegne	Severe: wetness, percs slowly	Slight	Severe: wetness, too clayey	Severe: wetness	Poor: too clayey, hard to pack, wetness
971:					
Hegne	Severe: wetness, percs slowly	Slight	Severe: wetness, too clayey	Severe: wetness	Poor: too clayey, hard to pack, wetness
Fargo	Severe: wetness, percs slowly	Slight	Severe: wetness, too clayey	Severe: wetness	Poor: too clayey, hard to pack, wetness

Table 16.—Sanitary Facilities--Continued

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "good," and other terms. Dashes indicate the map unit component was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation.)

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
1221:					
Maddock	Severe: poor filter	Severe: seepage	Severe: seepage, too sandy	Severe: seepage	Poor: seepage, too sandy
Hecla	Severe: wetness, poor filter	Severe: seepage, wetness	Severe: seepage, wetness, too sandy	Severe: seepage, wetness	Poor: seepage, too sandy
1267:					
Marysland	Severe: wetness, percs slowly	Severe: seepage, wetness	Severe: seepage, wetness	Severe: seepage, wetness	Poor: seepage, too sandy, small stones
1426:					
Parnell	Severe: ponding, percs slowly	Severe: ponding	Severe: ponding, too clayey	Severe: ponding	Poor: too clayey, hard to pack, ponding
1466:					
Pits, gravel and sand	Severe: poor filter, slope	Severe: seepage, slope	Severe: seepage, slope, too sandy	Severe: seepage, slope	Poor: seepage, too sandy, small stones
1710:					
Southam	Severe: ponding, percs slowly	Severe: ponding	Severe: ponding, too clayey	Severe: ponding	Poor: too clayey, hard to pack, ponding
1782:					
Swenoda	Severe: wetness, percs slowly	Severe: seepage, wetness	Moderate: wetness, too clayey	Severe: seepage	Fair: too clayey, wetness
1884:					
Vallers	Severe: wetness, percs slowly	Severe: wetness	Severe: wetness	Severe: wetness	Poor: wetness
Parnell	Severe: ponding, percs slowly	Severe: ponding	Severe: ponding, too clayey	Severe: ponding	Poor: too clayey, hard to pack, ponding
1886:					
Hamerly	Severe: wetness, percs slowly	Severe: wetness	Severe: wetness	Severe: wetness	Fair: too clayey, wetness
Vallers	Severe: wetness, percs slowly	Severe: wetness	Severe: wetness	Severe: wetness	Poor: wetness

Table 16.—Sanitary Facilities--Continued

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "good," and other terms. Dashes indicate the map unit component was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation.)

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
1978:					
Water	—	—	—	—	—
2048:					
Wyndmere	Severe: wetness, poor filter	Severe: seepage, wetness	Severe: seepage, wetness, too sandy	Severe: seepage, wetness	Poor: too sandy
2151:					
Binford	Severe: poor filter	Severe: seepage	Severe: seepage, too sandy	Severe: seepage	Poor: seepage, too sandy, small stones
Coe	Severe: poor filter	Severe: seepage	Severe: seepage, too sandy	Severe: seepage	Poor: seepage, too sandy, small stones
2196:					
Bearden	Severe: wetness, percs slowly	Severe: wetness	Severe: wetness	Severe: wetness	Fair: too clayey, wetness
Colvin	Severe: wetness, percs slowly	Severe: wetness	Severe: wetness	Severe: wetness	Poor: wetness
2208:					
Brantford	Severe: poor filter	Severe: seepage	Severe: seepage, too sandy	Severe: seepage	Poor: seepage, too sandy, small stones
Coe	Severe: poor filter	Severe: seepage	Severe: seepage, too sandy	Severe: seepage	Poor: seepage, too sandy, small stones
2286:					
Aberdeen	Severe: wetness, percs slowly	Moderate: seepage	Severe: wetness, too clayey, too sandy	Severe: wetness	Poor: too clayey, hard to pack, excess sodium
Bearden	Severe: wetness, percs slowly	Severe: wetness	Severe: wetness, too clayey	Severe: wetness	Poor: too clayey, hard to pack

Table 16.—Sanitary Facilities--Continued

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "good," and other terms. Dashes indicate the map unit component was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation.)

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
2287:					
Bearden	Severe: wetness, percs slowly	Severe: wetness	Severe: wetness, too clayey	Severe: wetness	Poor: too clayey, hard to pack
Lindaas	Severe: ponding, percs slowly	Severe: ponding	Severe: ponding	Severe: ponding	Poor: ponding
2288:					
Brantford	Severe: poor filter	Severe: seepage	Severe: seepage, too sandy	Severe: seepage	Poor: seepage, too sandy, small stones
Divide	Severe: wetness, poor filter	Severe: seepage, wetness	Severe: seepage, wetness, too sandy	Severe: seepage, wetness	Poor: seepage, too sandy, small stones
2289:					
Buse	Severe: percs slowly, slope	Severe: slope	Severe: slope	Severe: slope	Poor: slope
Svea	Severe: percs slowly, slope	Severe: slope	Severe: slope	Severe: slope	Poor: slope
Lamoure	Severe: flooding, wetness, percs slowly	Severe: flooding, wetness	Severe: flooding, wetness	Severe: flooding, wetness	Poor: hard to pack, wetness
2290:					
Coe	Severe: poor filter	Severe: seepage, slope	Severe: seepage, too sandy	Severe: seepage	Poor: seepage, too sandy, small stones
Binford	Severe: poor filter	Severe: seepage, slope	Severe: seepage, too sandy	Severe: seepage	Poor: seepage, too sandy, small stones
2291:					
Great Bend	Severe: percs slowly	Moderate: seepage, slope	Moderate: too clayey	Slight	Fair: too clayey
Zell	Moderate: percs slowly	Moderate: seepage, slope	Slight	Slight	Good

Table 16.—Sanitary Facilities--Continued

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "good," and other terms. Dashes indicate the map unit component was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation.)

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
2292:					
Hamerly	Severe: wetness, percs slowly	Severe: wetness	Severe: wetness	Severe: wetness	Fair: too clayey, wetness
Barnes	Severe: percs slowly	Moderate: seepage	Moderate: too clayey	Slight	Fair: too clayey
2293:					
Lamoure	Severe: flooding, wetness, percs slowly	Severe: flooding, wetness	Severe: flooding, wetness	Severe: flooding, wetness	Poor: hard to pack, wetness
Colvin	Severe: flooding, wetness, percs slowly	Severe: flooding, wetness	Severe: flooding, wetness	Severe: flooding, wetness	Poor: wetness
2324:					
Wyndmere	Severe: wetness, percs slowly, poor filter	Severe: seepage, wetness	Severe: wetness, too sandy	Severe: seepage, wetness	Poor: too sandy
Tiffany	Severe: wetness, percs slowly	Severe: seepage, wetness	Severe: seepage, wetness	Severe: seepage, wetness	Fair: too clayey, wetness

Table 17.—Construction Materials

(Some terms that describe restrictive features are defined in the Glossary. See text for definitions of "good," "fair," or other terms. Dashes indicate the map unit component was not rated. The information in this table indicate the dominant soil condition but does not eliminate the need for onsite investigation.)

Map symbol and soil name	Roadfill	Sand	Gravel	Topsoil
118:				
Barnes	Poor: low strength	Improbable: excess fines	Improbable: excess fines	Fair: small stones
Buse	Poor: low strength	Improbable: excess fines	Improbable: excess fines	Fair: too clayey, small stones
120:				
Barnes	Poor: low strength	Improbable: excess fines	Improbable: excess fines	Fair: small stones
Buse	Poor: low strength	Improbable: excess fines	Improbable: excess fines	Fair: too clayey, small stones
154:				
Barnes	Poor: low strength	Improbable: excess fines	Improbable: excess fines	Fair: small stones
Svea	Poor: low strength	Improbable: excess fines	Improbable: excess fines	Fair: small stones
167:				
Bearden	Poor: shrink-swell, low strength	Improbable: excess fines	Improbable: excess fines	Fair: thin layer
314:				
Buse	Poor: low strength	Improbable: excess fines	Improbable: excess fines	Fair: too clayey, small stones, slope
Barnes	Poor: low strength	Improbable: excess fines	Improbable: excess fines	Fair: small stones, slope
450:				
Colvin	Poor: low strength, wetness	Improbable: excess fines	Improbable: excess fines	Poor: wetness
511:				
Divide	Fair: wetness	Probable	Probable	Poor: too sandy, small stones, area reclaim
553:				
Egeland	Good	Improbable: excess fines	Improbable: excess fines	Fair: small stones
Embden	Good	Improbable: excess fines	Improbable: excess fines	Good

Table 17.—Construction Materials--Continued

(Some terms that describe restrictive features are defined in the Glossary. See text for definitions of "good,", "fair," or other terms. Dashes indicate the map unit component was not rated. The information in this table indicate the dominant soil condition but does not eliminate the need for onsite investigation.)

Map symbol and soil name	Roadfill	Sand	Gravel	Topsoil
846:				
Great Bend	Poor: low strength	Improbable: excess fines	Improbable: excess fines	Fair: too clayey
Overly	Poor: low strength	Improbable: excess fines	Improbable: excess fines	Fair: thin layer
871:				
Hamerly	Fair: shrink-swell, low strength, wetness	Improbable: excess fines	Improbable: excess fines	Fair: small stones
Cresbard	Poor: low strength	Improbable: excess fines	Improbable: excess fines	Poor: too clayey, excess sodium
883:				
Hamerly	Fair: shrink-swell, low strength, wetness	Improbable: excess fines	Improbable: excess fines	Fair: small stones
Tonka	Poor: low strength, wetness	Improbable: excess fines	Improbable: excess fines	Poor: too clayey, wetness
Parnell	Poor: shrink-swell, low strength, wetness	Improbable: excess fines	Improbable: excess fines	Poor: wetness
926:				
Hecla	Good	Probable	Improbable: too sandy	Poor: too sandy
966:				
Hegne	Poor: shrink-swell, low strength, wetness	Improbable: excess fines	Improbable: excess fines	Poor: too clayey, excess salt, wetness
971:				
Hegne	Poor: shrink-swell, low strength, wetness	Improbable: excess fines	Improbable: excess fines	Poor: too clayey, wetness
Fargo	Poor: shrink-swell, low strength, wetness	Improbable: excess fines	Improbable: excess fines	Poor: too clayey, wetness
1221:				
Maddock	Good	Probable	Improbable: too sandy	Poor: too sandy
Hecla	Good	Probable	Improbable: too sandy	Poor: too sandy

Table 17.—Construction Materials--Continued

(Some terms that describe restrictive features are defined in the Glossary. See text for definitions of "good," "fair," or other terms. Dashes indicate the map unit component was not rated. The information in this table indicate the dominant soil condition but does not eliminate the need for onsite investigation.)

Map symbol and soil name	Roadfill	Sand	Gravel	Topsoil
1267:				
Marysland	Poor: wetness	Probable	Probable	Poor: small stones, area reclaim, wetness
1426:				
Parnell	Poor: shrink-swell, low strength, wetness	Improbable: excess fines	Improbable: excess fines	Poor: wetness
1466:				
Pits, gravel and sand	Poor: slope	Probable	Probable	Poor: too sandy, small stones, area reclaim
1710:				
Southam	Poor: shrink-swell, low strength, wetness	Improbable: excess fines	Improbable: excess fines	Poor: too clayey, wetness
1782:				
Swenoda	Poor: low strength	Improbable: excess fines	Improbable: excess fines	Fair: small stones
1884:				
Vallers	Poor: low strength, wetness	Improbable: excess fines	Improbable: excess fines	Poor: excess salt, wetness
Parnell	Poor: shrink-swell, low strength, wetness	Improbable: excess fines	Improbable: excess fines	Poor: wetness
1886:				
Hamerly	Poor: low strength	Improbable: excess fines	Improbable: excess fines	Poor: excess salt
Vallers	Poor: low strength, wetness	Improbable: excess fines	Improbable: excess fines	Poor: excess salt, wetness
1978:				
Water	—	—	—	—
2048:				
Wyndmere	Fair: wetness	Improbable: excess fines	Improbable: excess fines	Fair: thin layer

Table 17.—Construction Materials--Continued

(Some terms that describe restrictive features are defined in the Glossary. See text for definitions of "good,", "fair," or other terms. Dashes indicate the map unit component was not rated. The information in this table indicate the dominant soil condition but does not eliminate the need for onsite investigation.)

Map symbol and soil name	Roadfill	Sand	Gravel	Topsoil
2151:				
Binford	Good	Probable	Probable	Poor: too sandy, small stones, area reclaim
Binford	Good			Prob

Table 17.—Construction Materials--Continued

(Some terms that describe restrictive features are defined in the Glossary. See text for definitions of "good," "fair," or other terms. Dashes indicate the map unit component was not rated. The information in this table indicate the dominant soil condition but does not eliminate the need for onsite investigation.)

Map symbol and soil name	Roadfill	Sand	Gravel	Topsoil
2289:				
Buse	Poor: low strength	Improbable: excess fines	Improbable: excess fines	Poor: slope
Svea	Poor: low strength	Improbable: excess fines	Improbable: excess fines	Poor: slope
Lamoure	Poor: low strength, wetness	Improbable: excess fines	Improbable: excess fines	Poor: wetness
2290:				
Coe	Good	Probable	Probable	Poor: too sandy, small stones, area reclaim
Binford	Good	Probable	Probable	Poor: too sandy, small stones, area reclaim
2291:				
Great Bend	Poor: low strength	Improbable: excess fines	Improbable: excess fines	Fair: too clayey
Zell	Good	Improbable: excess fines	Improbable: excess fines	Good
2292:				
Hamerly	Fair: shrink-swell, low strength, wetness	Improbable: excess fines	Improbable: excess fines	Fair: small stones
Barnes	Poor: low strength	Improbable: excess fines	Improbable: excess fines	Fair: small stones
2293:				
Lamoure	Poor: low strength, wetness	Improbable: excess fines	Improbable: excess fines	Poor: wetness
Colvin	Poor: low strength, wetness	Improbable: excess fines	Improbable: excess fines	Poor: wetness
2324:				
Wyndmere	Fair: thin layer, wetness	Improbable: excess fines	Improbable: excess fines	Fair: thin layer
Tiffany	Poor: low strength	Improbable: excess fines	Improbable: excess fines	Good

Table 18.--Water Management

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Dashes indicate that the map unit component was not evaluated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation.)

	Limitations for -			Features affecting -			
Map symbol and soil name	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Irrigation	Terraces and diversions	Grassed waterways
118:							
Barnes--------	Moderate: seepage, slope	Severe: piping	Severe: no water	Deep to water	Slope	Erodes easily	Erodes easily
Buse----------	Moderate: seepage, slope	Severe: piping	Severe: no water	Deep to water	Slope	Erodes easily	Erodes easily
120:							
Barnes--------	Moderate: seepage, slope	Severe: piping	Severe: no water	Deep to water	Slope	Erodes easily	Erodes easily
Buse----------	Moderate: seepage, slope	Severe: piping	Severe: no water	Deep to water	Slope	Erodes easily	Erodes easily
154:							
Barnes--------	Moderate: seepage	Severe: piping	Severe: no water	Deep to water	Favorable	Erodes easily	Erodes easily
Svea----------	Moderate: seepage	Severe: piping	Severe: slow refill	Deep to water	Favorable	Erodes easily	Erodes easily
167:							
Bearden-------	Moderate: seepage	Severe: piping, wetness	Severe: slow refill	Percs slowly, frost action	Wetness	Erodes easily, wetness, percs slowly	Erodes easily,
314:							
Buse----------	Severe: slope	Severe: piping	Severe: no water	Deep to water	Slope	Slope, erodes easily	Slope, erodes easily
Barnes--------	Severe: slope	Severe: piping	Severe: no water	Deep to water	Slope	Slope, erodes easily	Slope, erodes easily
450:							
Colvin--------	Moderate: seepage	Severe: piping, wetness	Severe: slow refill	Frost action	Wetness	Erodes easily, wetness	Wetness, erodes easily
511:							
Divide--------	Severe: seepage	Severe: seepage, piping, wetness	Severe: slow refill, cutbanks cave	Cutbanks cave	Wetness	Wetness, too sandy	Favorable

Table 18.--Water Management--Continued

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Dashes indicate that the map unit component was not evaluated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation.)

	Limitations for -			Features affecting -			
Map symbol and soil name	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Irrigation	Terraces and diversions	Grassed waterways
553:							
Egeland-------	Severe: seepage	Severe: seepage, piping	Severe: no water	Deep to water	Soil blowing	Too sandy, soil blowing	Favorable
Embden--------	Severe: seepage	Severe: seepage, piping	Severe: cutbanks cave	Deep to water	Soil blowing	Soil blowing	Favorable
846:							
Great Bend----	Moderate: seepage	Severe: piping	Severe: no water	Deep to water	Favorable	Erodes easily	Erodes easily
Overly--------	Slight	Severe: piping	Severe: slow refill	Deep to water	Percs slowly	Erodes easily	Erodes easily, percs slowly
871:							
Hamerly-------	Moderate: seepage	Severe: piping, wetness	Severe: slow refill	Frost action	Wetness	Erodes easily, wetness	Erodes easily
Cresbard------	Slight	Severe: excess sodium	Severe: slow refill	Deep to water	Percs slowly, excess sodium	Favorable	Excess sodium, percs slowly
883:							
Hamerly-------	Moderate: seepage	Severe: piping, wetness	Severe: slow refill	Frost action	Wetness	Erodes easily, wetness	Erodes easily
Tonka---------	Moderate: seepage	Severe: ponding	Severe: slow refill	Ponding, percs slowly, frost action	Ponding, percs slowly, erodes easily	Erodes easily, ponding, percs slowly	Wetness, erodes easily, percs slowly
Parnell-------	Slight	Severe: hard to pack, ponding	Severe: slow refill	Ponding, percs slowly, frost action	Ponding, percs slowly	Erodes easily, ponding, percs slowly	Wetness, erodes easily, percs slowly
926:							
Hecla---------	Severe: seepage	Severe: seepage, piping	Severe: cutbanks cave	Deep to water	Droughty, fast intake, soil blowing	Too sandy, soil blowing	Droughty

Table 18.--Water Management--Continued

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Dashes indicate that the map unit component was not evaluated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation.)

	Limitations for -			Features affecting -			
Map symbol and soil name	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Irrigation	Terraces and diversions	Grassed waterways
966:							
Hegne---------	Slight	Severe: hard to pack, wetness	Severe: slow refill	Percs slowly, frost action, excess salt,	Wetness, droughty, slow intake	Wetness, percs slowly	Wetness, excess salt, droughty
971:							
Hegne---------	Slight	Severe: hard to pack, wetness	Severe: slow refill	Percs slowly, frost action	Wetness, slow intake, percs slowly	Wetness, percs slowly	Wetness, percs slowly
Fargo---------	Slight	Severe: hard to pack, wetness	Severe: slow refill	Percs slowly, frost action	Wetness, slow intake, percs slowly	Wetness, percs slowly	Wetness, percs slowly
1221:							
Maddock-------	Severe: seepage	Severe: seepage, piping	Severe: no water	Deep to water	Slope, droughty, fast intake	Too sandy, soil blowing	Droughty
Hecla---------	Severe: seepage	Severe: seepage, piping	Severe: cutbanks cave	Deep to water	Droughty, fast intake, soil blowing	Too sandy, soil blowing	Droughty
1267:							
Marysland-----	Severe: seepage	Severe: seepage, wetness	Severe: slow refill, cutbanks cave	Frost action, cutbanks cave	Wetness	Wetness, too sandy	Wetness
1426:							
Parnell-------	Slight	Severe: hard to pack, ponding	Severe: slow refill	Ponding, percs slowly, frost action	Ponding, percs slowly	Erodes easily, ponding, percs slowly	Wetness, erodes easily, percs slowly
1466:							
Pits, gravel and sand------	Severe: seepage, slope	Severe: seepage	Severe: no water	Deep to water	Slope, droughty, fast intake	Slope, too sandy	Slope, droughty
1710:							
Southam-------	Slight	Severe: thin layer, ponding	Severe: slow refill	Ponding, percs slowly, frost action	Ponding, percs slowly	Erodes easily, ponding, percs slowly	Wetness, excess salt, erodes easily
1782:							
Swenoda-------	Severe: seepage	Severe: piping	Severe: no water	Deep to water	Slope, soil blowing	Erodes easily, soil blowing	Erodes easily

Table 18.--Water Management--Continued

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Dashes indicate that the map unit component was not evaluated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation.)

	Limitations for -			Features affecting -			
Map symbol and soil name	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Irrigation	Terraces and diversions	Grassed waterways
1884:							
Vallers-------	Moderate: seepage	Severe: piping, wetness	Severe: slow refill	Frost action, excess salt	Wetness, excess salt	Erodes easily, wetness	Wetness, excess salt, erodes easily
Parnell-------	Slight	Severe: hard to pack, ponding	Severe: slow refill	Ponding, percs slowly, frost action	Ponding, percs slowly	Erodes easily, ponding, percs slowly	Wetness, erodes easily, percs slowly
1886:							
Hamerly-------	Moderate: seepage	Severe: piping, wetness	Severe: slow refill	Frost action, excess salt	Wetness, excess salt	Erodes easily, wetness	Excess salt, erodes easily
Vallers-------	Moderate: seepage	Severe: piping, wetness	Severe: slow refill	Frost action, excess salt	Wetness, excess salt	Erodes easily, wetness	Wetness, excess salt, erodes easily
1978:							
Water--------	--	--	--	--	--	--	--
2048:							
Wyndmere------	Severe: seepage	Severe: piping, wetness	Severe: cutbanks cave	Frost action, cutbanks cave	Wetness, droughty	Wetness, too sandy, soil blowing	Droughty
2151:							
Binford-------	Severe: seepage	Severe: seepage	Severe: no water	Deep to water	Slope, droughty, soil blowing	Too sandy, soil blowing	Droughty
Coe-----------	Severe: seepage	Severe: seepage	Severe: no water	Deep to water	Slope, droughty, soil blowing	Large stones, too sandy	Large stones, draughty
2196:							
Bearden-------	Moderate: seepage	Severe: piping, wetness	Severe: slow refill	Frost action, excess salt	Wetness, excess salt	Erodes easily, wetness	Excess salt, erodes easily
Colvin--------	Moderate: seepage	Severe: wetness	Severe: slow refill	Percs slowly, frost action	Wetness, percs slowly, erodes easily	Erodes easily, wetness, percs slowly	Wetness, excess salt, erodes easily
2208:							
Brantford-----	Severe: seepage	Severe: seepage	Severe: no water	Deep to water	Slope, droughty	Large stones, too sandy	Large stones, droughty

Table 18.--Water Management--Continued
(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Dashes indicate that the map unit component was not evaluated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation.)

	Limitations for -			Features affecting -			
Map symbol and soil name	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Irrigation	Terraces and diversions	Grassed waterways
2208:(con't)							
Coe----------	Severe: seepage	Severe: seepage	Severe: no water	Deep to water	Slope, droughty	Large stones, too sandy	Large stones, droughty
2286:							
Aberdeen------	Moderate: seepage	Severe: piping, excess sodium	Severe: slow refill, cutbanks cave	Deep to water	Percs slowly, excess sodium	Erodes easily, percs slowly	Excess sodium, erodes easily, percs slowly
Bearden-------	Moderate: seepage	Severe: piping, wetness	Severe: slow refill	Percs slowly, frost action	Wetness	Erodes easily, wetness, percs slowly	Erodes easily, percs slowly
2287:							
Bearden-------	Moderate: seepage	Severe: piping, wetness	Severe: slow refill	Percs slowly, frost action	Wetness	Erodes easily, wetness, percs slowly	Erodes easily, percs slowly
Lindaas-------	Moderate: seepage	Severe: piping, ponding	Severe: no water	Ponding, percs slowly, frost action	Ponding, percs slowly	Erodes easily, ponding	Wetness, erodes easily, percs slowly
2288:							
Brantford-----	Severe: seepage	Severe: seepage	Severe: no water	Deep to water	Droughty	Large stones, too sandy	Large stones, droughty
Divide--------	Severe: seepage	Severe: seepage, piping, wetness	Severe: slow refill, cutbanks cave	Cutbanks cave	Wetness	Wetness, too sandy	Favorable
2289:							
Buse----------	Severe: slope	Severe: piping	Severe: no water	Deep to water	Slope	Slope, erodes easily	Slope, erodes easily
Svea----------	Severe: slope	Severe: piping	Severe: no water	Deep to water	Slope	Slope, erodes easily	Slope, erodes easily
Lamoure-------	Moderate: seepage	Severe: hard to pack, wetness	Severe: slow refill	Flooding, frost action	Wetness, flooding	Erodes easily, wetness	Wetness, erodes easily
2290:							
Coe-----------	Severe: seepage, slope	Severe: seepage	Severe: no water	Deep to water	Slope, droughty, soil blowing	Slope, large stones, too sandy	Large stones, slope, droughty

Table 18.--Water Management--Continued

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Dashes indicate that the map unit component was not evaluated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation.)

Map symbol and soil name	Limitations for -			Features affecting -			
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Irrigation	Terraces and diversions	Grassed waterways
2290: (con't)							
Binford-------	Severe: seepage, slope	Severe: seepage	Severe: no water	Deep to water	Slope, droughty, soil blowing	Slope, too sandy, soil blowing	Slope, droughty
2291:							
Great Bend----	Moderate: seepage, slope	Severe: piping	Severe: no water	Deep to water	Slope	Erodes easily	Erodes easily
Zell----------	Moderate: seepage, slope	Severe: piping	Severe: no water	Deep to water	Slope	Erodes easily	Erodes easily
2292:							
Hamerly-------	Moderate: seepage	Severe: piping, wetness	Severe: slow refill	Frost action	Wetness	Erodes easily, wetness	Erodes easily
Barnes--------	Moderate: seepage	Severe: piping	Severe: no water	Deep to water	Favorable	Erodes easily	Erodes easily
2293:							
Lamoure-------	Moderate: seepage	Severe: hard to pack, wetness	Severe: slow refill	Flooding, frost action	Wetness, flooding	Erodes easily, wetness	Wetness, erodes easily
Colvin--------	Moderate: seepage	Severe: piping, wetness	Severe: slow refill	Flooding, frost action	Wetness	Erodes easily, wetness	Wetness, erodes easily
2324:							
Wyndmere------	Severe: seepage	Severe: piping, wetness	Severe: slow refill, cutbanks cave	Frost action, cutbanks cave	Wetness	Wetness, too sandy	Favorable
Tiffany-------	Severe: seepage	Severe: piping, wetness	Severe: slow refill	Frost action	Wetness	Erodes easily, wetness	Erodes easily

Soil Properties

Data relating to soil properties are collected during the course of the soil survey. The data and estimates of soil and water features listed in tables are explained on the following pages.

Soil properties are determined by or estimated from the field examination of soils and laboratory testing. During the survey, many shallow borings are made and examined to identify and classify soils and delineate them on soil maps. Samples are taken from some typical soils and tested in the laboratory to determine physical and chemical soil properties. Standard laboratory procedures are followed. Information from the laboratory and results from samples from similar soils in nearby areas are used to verify field observations and properties that cannot be estimated accurately in the field. The laboratory analyses also help to characterize key soils.

Estimates of soil properties shown in the tables include the range of soil texture, Atterberg limits, engineering classifications, and other physical and chemical properties of the major layers of each soil. Pertinent soil and water features are also given.

Each soil map unit was documented by at least one pedon description for each soil series identified in its name. Pedons were sampled for engineering properties. The analyses were made by the North Dakota State Department of Transportation.

Engineering Index Properties

Table 19 “Engineering Index Properties,” gives estimates of the engineering classification and range of index properties for major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given in the series descriptions under the heading “Soil Series and Their Morphology.”

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter. “Loam,” for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is as much as 15 percent, an appropriate modifier is added, for example, “gravelly.” Textural terms are defined in the “Glossary.”

Classification of the soils is determined according to the Unified soil classification system (ASTM, 1993) and the system adopted by the American Association of State Highway and Transportation Officials (AASHTO, 1986).

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as PT. Soils exhibiting engineering properties of two groups can have a dual classification, for example, SP-SM.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups, from A-1 through A-7, on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6.

Rock fragments larger than 10 inches in diameter and 3 to 10 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an ovendry weight. The sieves, numbers 4, 10, 40, and

200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

Liquid limit and plasticity index (Atterberg limits) indicate the plasticity characteristics of a soil. Estimates are based on test data from the survey area or from nearby areas and on field examination.

Estimates of grain-size distribution, liquid limit, and plasticity index are generally rounded to the nearest 5 percent. Thus, if the ranges of gradation and Atterberg limits extend a marginal amount (1 or 2 percentage points) across classification boundaries, the classification in the marginal zone is omitted in the table.

Physical Properties

Table 20, "Physical Properties of the Soils," shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and test data for these and similar soils.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given in the series descriptions under the heading "Soil Series and Their Morphology."

Clay consists of mineral soil particles that are less than 0.002 millimeter in diameter. The estimated clay content of each major soil layer is given as a percentage, by weight, of the soil material less than 2 millimeters in diameter.

The amount and kind of clay greatly affect the fertility and physical condition of the soil. Clay determines the ability of soil to adsorb cations and retain moisture. Clay influences shrink-swell potential, permeability, plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earth-moving operations.

Moist bulk density is the weight of soil (ovendry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at 1/3 bar moisture tension. Weight is determined after drying the soil at 105 degrees C. In Table 20 "Physical Properties of Soils," the estimated range in moist bulk density of each major soil layer is expressed in grams per cubic centimeter of soil material less than 2 millimeters in diameter. Bulk density data are used to compute shrink-swell potential, available water capacity, total pore space, and other soil properties. Moist bulk density of a soil indicates the pore space available for water and roots. A bulk density of more than 1.6 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, organic matter content, and soil structure.

Permeability refers to the ability of a soil to transmit water or air. The estimates indicate the rate of downward movement of water when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems and septic tank absorption fields.

Available water capacity refers to the quantity of water the soil is capable of storing for use by plants. The range in the capacity for water storage is given in inches of water per inch of soil for each major soil layer. The capacity varies, depending on soil properties that affect retention of water and depth of the root zone. The most important soil properties are organic matter content, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

Shrink-swell potential is the potential for volume change in a soil with a loss or gain of moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. The magnitude of the load on the soil and magnitude of the change in soil moisture content influence the amount of swelling of soils in place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others, swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design features are often needed.

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The classes are **low,** a change of less than 3 percent; **moderate,** 3 to 6 percent; and **high,** more than 6 percent. **Very high,** more than 9 percent, is sometimes used.

Organic matter is the plant and animal residue in the soil at various stages of decomposition. In Table 20, "Physical Properties of Soils," the estimated range

in organic matter content is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of organic matter in a soil can be maintained or increased by returning crop residue to the soil. Organic matter affects available water capacity, infiltration rates, and tilth. It is a source of nitrogen and other nutrients for crops.

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Soil properties that influence erodibility are those that affect the infiltration rate, movement of water though the soil, water storage capacity of the soil, and those that allow the soil to resist dispersion, splashing, abrasion, and the transporting forces of rainfall and runoff. The most important soil properties are the content of silt, sand, and organic matter and soil structure and permeability. The factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are modified by the presence of rock fragments. Values of K range from 0.02 to 0.69. The higher the value, the more susceptible the soil is to sheet and rill erosion.

Erosion factor Kf is similar to the erosion factor K, except it indicates the erodibility of only the fine-earth fraction, or the material less than 2 millimeters in size.

Soil-loss tolerance factor T is an estimate of the maximum annual rate of soil erosion by wind or water that can occur without affecting crop productivity over a sustained period. The rate is expressed in tons per acre per year. Ratings of 1 to 5 are used depending on soil properties and prior erosion. The criteria used in assigning a T factor to a soil include maintenance of adequate rooting depth for crop production, potential reduction of crop yields, maintenance of water-control structures affected by sedimentation, prevention of gullying, and the value of nutrients lost through erosion.

Wind erodibility groups (WEG) are made up of soils that have similar properties affecting their resistance to wind erosion in cultivated areas. The groups indicate the susceptibility of soil to wind erosion. Soils are grouped according to the following distinctions:

WEG 1. Coarse sands, sands, fine sands, and very fine sands. These soils generally are not suitable for crops. They are extremely erodible, and vegetation is difficult to establish.

WEG 2. Loamy coarse sands, loamy sands, loamy fine sands, loamy very fine sands, and sapric soil material. These soils are very highly erodible. Crops can be grown if intensive measures to control wind erosion are used.

WEG 3. Coarse sandy loams, sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly erodible. Crops can be grown if intensive measures to control wind erosion are used.

WEG 4L. Calcareous loams, silt loams, clay loams, and silty clay loams. These soils are highly erodible. Crops can be grown if intensive measures to control wind erosion are used.

WEG 4. Clays, silty clays, noncalcareous clay loams, and silty clay loams that are more than 35 percent clay. These soils are highly erodible. Crops can be grown if measures to control wind erosion are used.

WEG 5. Noncalcareous loams and silt loams that are less than 20 percent clay and sandy clay loams, sandy clays, and hemic soil material. These soils are moderately erodible. Crops can be grown if measures to control wind erosion are used.

WEG 6. Noncalcareous loams and silt loams that are more than 20 percent clay and noncalcareous clay loams that are less than 35 percent clay. These soils are slightly erodible. Crops can be grown if ordinary measures to control wind erosion are used.

WEG 7. Silts, noncalcareous silty clay loams that are less than 35 percent clay, and fibric soil material. These soils are very slightly erodible. Crops can be grown if ordinary measures to control wind erosion are used.

WEG 8. Soils that are not subject to soil blowing because of rock fragments on the surface or because of surface wetness.

Wind erodibility index (I) is a numerical value indicating the potential annual soil loss due to wind erosion for a soil under a well defined set of climatic and management conditions. This factor is expressed as the average annual soil loss in tons per acre per year.

Chemical Properties

Table 21, “Chemical Properties of the Soils,” shows estimates of some soil chemical properties that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on test data for these and similar soils. These features are described in the following paragraphs.

Cation-exchange capacity is the total amount of exchangeable cations that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. Soils having a low cation-exchange capacity hold fewer cations and may require more frequent applications of fertilizer than soils having a high cation-

exchange capacity. The ability to retain cations helps to prevent pollution of groundwater.

Soil reaction is a measure of acidity or alkalinity and is expressed as a range in pH values. The range in pH of each major horizon is based on many field tests. For many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion.

Calcium carbonate equivalent is the percent of carbonates, by weight, in the soil. The availability of plant nutrients is influenced by the amount of carbonates in the soil. Incorporating nitrogen fertilizer into calcareous soils helps to prevent nitrite accumulation and ammonium-N volatilization. Calcium carbonate also affects susceptibility of a soil to wind erosion.

Gypsum is given as the percent, by weight, of hydrated calcium sulfates in the soil. Gypsum is partially soluble in water and can be dissolved and removed by water. Soils that have a high content of gypsum (more than 10 percent) may collapse if the gypsum is removed by percolating water.

Salinity is a measure of soluble salts in the soil at saturation. It is expressed as the electrical conductivity (EC) of the saturation extract, in millimhos per centimeter at 25 degrees C. Estimates are based on field and laboratory measurements at representative sites of nonirrigated soils. The salinity of irrigated soils is affected by the quality of the irrigation water and by the frequency of water application. Hence, the salinity of soils in individual fields can differ greatly from the value given in the table. Salinity affects the suitability of a soil for crop production, the stability of the soil if used as construction material, and the potential of the soil to corrode metal and concrete.

Sodium adsorption ratio (SAR) is the measure of sodium relative to calcium and magnesium in the water extract from a saturated soil paste. Soils having a sodium adsorption ratio of 13 or more may be characterized by an increased dispersion of organic matter and clay particles, reduced permeability and aeration, and a general degradation of soil structure.

Water Features

Table 22, “Water Features,” gives estimates of several important water features used in land use planning that involves engineering considerations. These features are described in the following paragraphs.

Hydrologic soil groups are groups of soils that have the same runoff potential under similar storm and ground cover conditions. Soil properties that affect the runoff potential are those that influence the rate of infiltration in a bare soil after prolonged wetting and when the soil is not frozen. These properties include the depth to a seasonal high water table, the intake rate, permeability after prolonged wetting, and the depth to a very slowly permeable layer. The influences of ground cover and slope are treated independently and are not taken into account in hydrologic soil groups.

In the definitions of the hydrologic soil groups, the infiltration rate is the rate at which water enters the soil at the surface and is controlled by surface conditions. The transmission rate is the rate at which water moves through the soil and is controlled by properties of the soil layers.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of very deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist mainly of moderately deep or deep, moderately well or well drained soils that have moderately fine to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist mainly of soils having a layer that impedes the downward movement of water or soils that have a moderately fine or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist mainly of clayey soils that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to two hydrologic groups,” the first letter is for drained areas and the second is for undrained areas.

Flooding, the temporary covering of the soil surface by flowing water, is caused by overflow from streams or by runoff from adjacent slopes. Shallow water standing or flowing for short periods after rainfall or snowmelt is not considered flooding. Standing water in marshes and swamps or in closed depressions is considered to be ponding.

Table 22, “Water Features,” gives the frequency and duration of flooding and the time of year when flooding is most likely to occur. Frequency, duration, and

probable dates of occurrence are estimated. Frequency generally is expressed as **none, rare, occasional,** or **frequent. None** means flooding is not probable; **rare** that it is unlikely but is possible under unusual weather conditions (the chance of flooding is nearly 0 percent to 5 percent in any year); **occasional** that it occurs infrequently under normal weather conditions (the chance of flooding is 5 to 50 percent in any year); and **frequent** that it occurs often under normal weather conditions (the chance of flooding is more than 50 percent in any year). The term **common** includes both frequent and occasional flooding.

Duration is expressed as **very brief** (less than 2 days), **brief** (2 to 7 days), **long** (7 to 30 days), and **very long** (more than 30 days). The time of year that flooding is most likely to occur is expressed in months. About two-thirds to three-fourths of all flooding occurs during the stated period.

The information on flooding is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and little or no horizon development.

Also considered are local information about the extent and level of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table (seasonal) is the highest average depth of a zone of saturation during the wettest season in most years. It is at least 6 inches thick, persists in the soil for more than a few weeks, and is within 6 feet of the surface. The estimates are based mainly on the evidence of a saturated zone, namely a combination of grayish colors or redoximorphic features in the soil. Indicated in Table 22, “Water Features,” are the depth to the seasonal high water table, the kind of water table, and the months of the year when the water table usually is highest.

An **apparent** water table is indicated by the level at which water stands in a freshly dug, unlined borehole after adequate time is allowed for adjustments in the surrounding soil.

A **perched** water table is water standing above an unsaturated zone in the soil. A perched water table may be separated from a lower water table by an unsaturated zone. Water tables usually are perched by textural discontinuities in the soil profile. A perched water table may be confirmed if the water level in a borehole falls when the borehole is extended.

Two numbers in the column showing depth to the water table indicate the normal range in depth to a saturated zone. Depth is given to the nearest half foot. The first numeral in the range indicates the highest water level. A plus sign preceding the range in depth indicates the water table is above the surface of the soil. “Greater than 6.0” indicates the water table is below a depth of 6 feet or is within a depth of 6 feet for less than a month.

Ponding is standing water in a closed depression. Unless a drainage system is installed, the water is removed only by percolation, transpiration or evaporation. Ponding of soils is classified according to the depth, duration, and the beginning and ending months in which water is observed. **Maximum ponding depth** is the maximum depth of surface water that is ponded on the soil. **Ponding duration** is the length of time that ponding occurs. **Months** indicates which months ponding is most likely to occur.

Soil Features

Table 23, “Soil Features,” gives estimates of several important soil features used in land use planning that involves engineering considerations. These features are described in the following paragraphs.

Depth to bedrock is given if bedrock is within a depth of 60 inches. The depth is based on many soil borings and on observations during soil mapping. The rock is specified as either soft or hard. If the rock is soft or fractured, excavations can be made with trenching machines, backhoes, or small rippers. If the rock is hard or massive, blasting or special equipment generally is needed for excavation.

Potential frost action is the likelihood of upward or lateral expansion of the soil caused by the formation of segregated ice lenses (frost heave) and the subsequent collapse of the soil and loss of strength on thawing. Frost action occurs when moisture moves into the freezing zone of the soil. Temperature, texture, density, permeability, organic matter content, and depth to the water table are the most important factors considered in evaluating the potential for frost action. It is assumed the soil is not insulated by vegetation or snow and is not artificially drained. Silty and highly structured, clayey soils that have a high water table in winter are the most susceptible to frost action. Well drained, very gravelly, or very sandy soils are the least susceptible. Frost heave and low soil strength during thawing cause damage to pavements and other rigid structures.

A **low** potential for frost action indicates that the soil is rarely susceptible to the formation of ice lenses; a **moderate** potential indicates that the soil is susceptible to formation of ice lenses, resulting in frost heave and the subsequent loss of soil strength; and a

high potential indicates that the soil is highly susceptible to formation of ice lenses, resulting in frost heave and the subsequent loss of soil strength.

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil.

Special site examination and design features may be needed if the combination of factors results in a severe hazard of corrosion. Steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as **low, moderate,** or **high,** is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion is also expressed as **low, moderate,** or **high**. It is based on soil texture, acidity, and amount of sulfates in the saturation extract.

Hydric Soils

Table 24, “Hydric Soils List,” shows which map units have components that meet the definition of hydric soils in Towner County. This table can help in planning land uses; however, on-site investigation is recommended to determine the hydric soils on a specific site (National Research Council, 1995; USDA-NRCS, 1996.) Map units that are made up of hydric soils may have small areas or inclusions, of nonhydric soils in the higher positions on the landform, and map units made up of nonhydric soils may have inclusions of hydric soils in the lower positions of the landform.

Three essential characteristics of wetlands are hydrophytic vegetation, hydric soils, and wetland hydrology (Cowardin, et al., 1979; Environmental Laboratory, 1987; National Research Council, 1995; Tiner, 1985). Criteria for each of the characteristics must be met for areas to be identified as wetlands. Undrained hydric soils that have natural vegetation should support a dominant population of ecological wetland plant species. Hydric soils that have been converted to other uses should be capable of being restored to wetlands.

Hydric soils are defined by the National Technical Committee for Hydric Soils (NTCHS) as soils that formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part (Federal Register, 1994). These soils are either saturated or inundated long enough during the growing season to support the growth and reproduction of hydrophytic vegetation.

The NTCHS definition identifies general soil properties that are associated with wetness. In order to determine whether a specific soil is a hydric soil or nonhydric soil, however, more specific information, such as information about the depth and duration of the water table, is needed. Thus, criteria which identify those estimated soil properties unique to hydric soils have been established (Federal Register, 1995.) These criteria are used to identify a phase of a soil series that normally is associated with wetlands. The criteria used are selected estimated soil properties that are described in “Soil Taxonomy” (Soil Survey Staff, 1975;1996a) and in the “Soil Survey Manual” (Soil Survey Staff, 1993.)

If soils are wet enough for a long enough period to be considered hydric, they should exhibit certain properties that can be easily observed in the field. These visible properties are indicators of hydric soils. The indicators that can be used to make on-site determinations of hydric soils in Towner County are specified in “Field Indicators of Hydric Soils in the United States” (USDA-NRCS, 1996).

Hydric soils are identified by examining and describing the soil to a depth of about 20 inches. This depth may be greater if determination of an appropriate indicator so requires. It is always recommended that soils be excavated and described as deep as necessary to understand the redoximorphic processes. Then, using the completed soil description, soil scientists can compare soil features required by each hydric soil indicator and specify which indicators have been matched with the conditions observed in the soil. The soil can be identified as a hydric soil if one (or more) of the approved indicators is present.

This survey can be used to locate probable areas of hydric soils. The hydric soil may have been artificially drained or otherwise altered such that it no longer supports a predominance of hydrophytic vegetation. The soil map does not identify drained areas.

Table 19.--Engineering Index Properties

(The symbol < means less than; > means more than. Dashes indicate that data were not estimated.)

Map symbol and soil name	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number --				Liquid limit	Plasti-city index
			Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
	Inches				Pct.	Pct.					Pct.	
118:												
Barnes--	0-6	Loam	CL, CL-ML	A-4, A-6	0	0-5	90-100	85-100	80-100	60-80	25-35	10-20
	6-18	Loam, clay loam	CL, CL-ML	A-4, A-6	0	0-5	90-100	85-100	75-95	55-80	25-45	10-25
	18-25	Loam, clay loam	CL, CL-ML	A-4, A-6	0	0-5	90-100	85-100	75-95	55-80	25-45	10-25
	25-60	Loam, clay loam	CL, CL-ML	A-4, A-6	0	0-5	90-100	85-100	75-95	55-80	25-45	10-25
Buse----	0-8	Loam	CL, CL-ML	A-4, A-6	0	0-5	90-100	85-95	70-95	55-90	25-35	10-15
	8-60	Loam, clay loam	CL, CL-ML	A-4,A-6, A-7	0	0-5	90-100	85-100	70-90	55-85	25-45	10-25
120:												
Barnes--	0-6	Loam	CL, CL-ML	A-4, A-6	0	0-5	90-100	85-100	80-100	60-80	25-35	10-20
	6-18	Loam, clay loam	CL, CL-ML	A-4, A-6	0	0-5	90-100	85-100	75-95	55-80	25-45	10-25
	18-25	Loam, clay loam	CL, CL-ML	A-4, A-6	0	0-5	90-100	85-100	75-95	55-80	25-45	10-25
	25-60	Loam, clay loam	CL, CL-ML	A-4, A-6	0	0-5	90-100	85-100	75-95	55-80	25-45	10-25
Buse----	0-8	Loam	CL, CL-ML	A-4, A-6	0	0-5	90-100	85-95	70-95	55-90	25-35	10-15
	8-60	Loam, clay loam	CL, CL-ML	A-4,A-6, A-7	0	0-5	90-100	85-100	70-90	55-85	25-45	10-25
154:												
Barnes--	0-6	Loam	CL, CL-ML	A-4, A-6	0	0-5	90-100	85-100	80-100	60-80	25-35	10-20
	6-18	Loam, clay loam	CL, CL-ML	A-4, A-6	0	0-5	90-100	85-100	75-95	55-80	25-45	10-25
	18-25	Loam, clay loam	CL, CL-ML	A-4, A-6	0	0-5	90-100	85-100	75-95	55-80	25-45	10-25
	25-60	Loam, clay loam	CL, CL-ML	A-4, A-6	0	0-5	90-100	85-100	75-95	55-80	25-45	10-25
Svea----	0-15	Loam	CL, CL-ML	A-4, A-6	0	0-5	95-100	85-100	80-95	60-90	25-40	10-20
	15-21	Loam, silt loam, clay loam	CL, CL-ML	A-4, A-6, A-7	0	0-5	95-100	85-100	80-100	60-90	25-45	10-25
	21-60	Loam, silt loam, clay loam	CL, CL-ML	A-4, A-6, A-7	0	0-5	95-100	85-100	80-100	60-85	25-45	10-25

Table 19.--Engineering Index Properties--Continued

(The symbol < means less than; > means more than. Dashes indicate that data were not estimated.)

Map symbol and soil name	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number --				Liquid limit	Plasti-city index
			Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
	Inches				Pct.	Pct.					Pct.	
167:												
Bearden-	0-7	Silt loam	CL-ML, CL	A-4, A-6	0	0	100	100	90-100	70-90	30-35	10-15
	7-12	Silt loam, silty clay loam	CL	A-6, A-7, A-4	0	0	100	100	90-100	80-95	30-45	10-20
	12-22	Silt loam, silty clay loam, loam	CL, CL-ML	A-6, A-7, A-4	0	0	100	100	90-100	80-95	30-45	10-20
	22-60	Silt loam, silty clay loam, silty clay	CL, CH, CL-ML	A-6, A-7	0	0	100	100	90-100	80-95	30-65	10-40
314:												
Buse----	0-8	Loam	CL, CL-ML	A-4, A-6	0	0-5	90-100	85-95	70-95	55-90	25-35	10-15
	8-60	Loam, clay loam	CL, CL-ML	A-4, A-6, A-7	0	0-5	90-100	85-100	70-90	55-85	25-45	10-25
Barnes--	0-6	Loam	CL, CL-ML	A-4, A-6	0	0-5	90-100	85-100	80-100	60-80	25-35	10-20
	6-18	Loam, clay loam	CL, CL-ML	A-4, A-6	0	0-5	90-100	85-100	75-95	55-80	25-45	10-25
	18-25	Loam, clay loam	CL, CL-ML	A-4, A-6	0	0-5	90-100	85-100	75-95	55-80	25-45	10-25
	25-60	Loam, clay loam	CL, CL-ML	A-4, A-6	0	0-5	90-100	85-100	75-95	55-80	25-45	10-25
450:												
Colvin--	0-11	Silt loam	CL, CL-ML	A-6, A-4	0	0	100	100	90-100	80-95	30-35	10-15
	11-43	Silt loam, silty clay loam	CL, CL-ML	A-6, A-7, A-4	0	0	100	100	90-100	80-95	30-45	10-20
	43-60	Loam, silt loam, silty clay loam	CL, CL-ML	A-6, A-7, A-4	0	0	100	100	90-100	70-95	30-45	10-20
511:												
Divide--	0-7	Loam	CL, CL-ML	A-4, A-6	0	0-5	95-100	95-100	85-95	60-85	25-35	5-15
	7-25	Loam, clay loam, gravelly loam	CL, CL-ML	A-6, A-7	0	0-5	95-100	75-100	55-90	35-80	30-45	10-25
	25-60	Stratified sand to gravelly sand	SM, GP-GM, SP-SM	A-1, A-3, A-2	0	0-5	25-100	15-100	10-70	5-25	0-15	NP-5

Table 19.--Engineering Index Properties--Continued

(The symbol < means less than; > means more than. Dashes indicate that data were not estimated.)

Map symbol and soil name	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number --				Liquid limit	Plasti-city index
			Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
	Inches				Pct.	Pct.					Pct.	
553:												
Egeland-	0-7	Fine sandy loam	SC-SM, SC	A-2, A-4	0	0	100	95-100	75-100	30-50	20-30	5-10
	7-26	Sandy loam, fine sandy loam	SC-SM, SC	A-2, A-4	0	0	95-100	85-100	70-100	15-50	20-30	5-10
	26-60	Loamy sand, loamy fine sand, loamy very fine sand	SM, SC-SM	A-2, A-4	0	0	95-100	85-100	70-100	10-50	15-20	NP-5
Embden--	0-14	Fine sandy loam	SC, CL-ML, SC-SM	A-2, A-4	0	0	100	100	60-95	30-75	20-30	4-10
	14-28	Fine sandy loam, sandy loam	SC, SC-SM, CL-ML	A-2, A-4	0	0	100	100	60-100	25-55	20-30	5-10
	28-60	Fine sandy loam, sandy loam, loamy fine sand	SM, SC, CL-ML	A-2, A-4	0	0	100	100	50-100	15-55	15-30	NP-10
846:												
Great												
Bend----	0-6	Silt loam	CL, CL-ML	A-4, A-6	0	0	100	100	95-100	90-100	30-35	10-15
	6-13	Silt loam, silty clay loam	CL, CL-ML	A-6, A-7, A-4	0	0	100	100	95-100	85-100	30-45	10-20
	13-30	Silt loam, silty clay loam	CL, CL-ML	A-6, A-7, A-4	0	0	100	100	95-100	85-100	30-45	10-20
	30-60	Stratified silt loam to silty clay loam	CL, CL-ML	A-4, A-6, A-7	0	0	100	100	95-100	85-100	30-45	10-20
Overly--	0-16	Silt loam	CL, CL-ML	A-6, A-7, A-4	0	0	100	100	90-100	85-100	25-45	5-25
	16-25	Silty clay loam, silt loam, clay loam	CL, CL-ML	A-6, A-7, A-4	0	0	100	100	90-100	80-100	25-50	5-30
	25-60	Stratified silt loam to silty clay	CL, CL-ML	A-6, A-7, A-4	0	0	100	100	90-100	80-100	25-50	5-30

Table 19.--Engineering Index Properties--Continued

(The symbol < means less than; > means more than. Dashes indicate that data were not estimated.)

Map symbol and soil name	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number --				Liquid limit	Plasti-city index
			Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
	Inches				Pct.	Pct.					Pct.	
871:												
Hamerly-	0-10	Loam	CL, CL-ML	A-4, A-6	0	0-5	95-100	90-100	80-95	60-90	20-40	5-20
	10-30	Loam, clay loam	CL, CL-ML	A-4, A-6, A-7	0	0-5	95-100	90-100	80-95	60-75	20-45	5-25
	30-60	Loam, clay loam	CL, CL-ML	A-4, A-6, A-7	0	0-5	95-100	90-100	75-95	55-75	20-45	5-25
Cresbard	0-12	Loam	ML, CL	A-4, A-6	0	0	100	100	85-100	60-80	30-40	5-15
	12-22	Clay loam, silty clay, clay	CL, CH	A-7, A-6	0	0	95-100	90-100	90-100	65-85	30-60	15-30
	22-29	Clay loam, silty clay, clay	CL, CH	A-7	0	0	95-100	90-100	85-100	65-85	40-60	15-30
	29-60	Clay loam, loam	CL, CH	A-6, A-7	0	0-5	95-100	90-100	85-100	50-80	25-55	10-27
883:												
Hamerly-	0-10	Loam	CL, CL-ML	A-4, A-6	0	0-5	95-100	90-100	80-95	60-90	20-40	5-20
	10-30	Loam, clay loam	CL, CL-ML	A-4, A-6, A-7	0	0-5	95-100	90-100	80-95	60-75	20-45	5-25
	30-60	Loam, clay loam	CL, CL-ML	A-4, A-6, A-7	0	0-5	95-100	90-100	75-95	55-75	20-45	5-25
Tonka---	0-18	Silt loam	CL, CL-ML	A-4, A-6	0-1	0-2	100	95-100	90-100	70-90	35-45	15-25
	18-42	Silty clay loam, clay loam, clay	CH, CL	A-6, A-7	0-1	0-2	100	95-100	90-100	75-95	50-60	30-40
	42-60	Silty clay loam, clay loam, loam	CL, CL-ML	A-6, A-7, A-4	0-1	0-3	90-100	85-100	60-100	50-90	35-55	15-30
Parnell-	0-27	Silty clay loam	CL, CH, OL	A-7	0	0-1	100	100	95-100	85-100	40-55	20-35
	27-45	Clay loam, silty clay loam, silty clay	CL, CH	A-7	0	0-2	100	95-100	90-100	70-100	50-75	30-50
	45-60	Clay loam, silty clay loam, silty clay	CL, CH	A-7	0	0-2	95-100	90-100	80-95	70-95	50-60	30-40

Table 19.--Engineering Index Properties--Continued

(The symbol < means less than; > means more than. Dashes indicate that data were not estimated.)

Map symbol and soil name	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number --				Liquid limit	Plasti-city index
			Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
	Inches				Pct.	Pct.					Pct.	
926:												
Hecla---	0-9	Loamy fine sand	SM, SC-SM, SP-SM	A-2	0	0	100	95-100	85-100	12-35	10-20	NP-5
	9-33	Loamy sand, loamy fine sand, fine sand	SM, SC-SM, SP-SM	A-2, A-3	0	0	100	95-100	85-100	5-35	10-20	NP-5
	33-60	Loamy sand, fine sand, loamy fine sand	SM, SC-SM, SP-SM	A-2, A-3	0	0	100	95-100	85-100	5-35	10-20	NP-5
966:												
Hegne---	0-7	Silty clay	CH	A-7	0	0	100	100	95-100	90-100	55-75	35-50
	7-32	Silty clay, clay	CH	A-7	0	0	100	100	95-100	95-100	55-75	30-50
	32-60	Silty clay, clay	CH	A-7	0	0	100	100	95-100	95-100	55-75	30-50
971:												
Hegne---	0-7	Silty clay	CH	A-7	0	0	100	100	95-100	90-98	55-75	35-50
	7-12	Silty clay, clay	CH	A-7	0	0	100	100	95-100	95-98	55-75	35-50
	12-32	Clay, silty clay, silty clay loam	CH	A-7	0	0	100	100	95-100	95-100	55-75	35-50
	32-60	Clay, silty clay, silty clay loam	CH	A-7	0	0	100	100	95-100	95-100	55-75	35-50
Fargo---	0-8	Silty clay	CH	A-7	0	0	100	100	95-100	85-100	50-75	25-50
	8-18	Silty clay, clay	CH	A-7	0	0	100	100	95-100	85-100	50-75	25-50
	18-60	Silty clay, clay	CH	A-7	0	0	100	100	95-100	85-100	50-75	25-50
1221:												
Maddock-	0-10	Loamy fine sand	SM, SC-SM	A-2	0	0	100	95-100	50-80	15-35	15-20	NP-5
	10-60	Loamy sand, loamy fine sand, fine sand	SM, SP-SM	A-2, A-3	0	0	100	95-100	60-100	5-35	15-20	NP-3

Table 19.--Engineering Index Properties--Continued

(The symbol < means less than; > means more than. Dashes indicate that data were not estimated.)

Map symbol and soil name	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number --				Liquid limit	Plasticity index
			Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
	Inches				Pct.	Pct.					Pct.	
1267:												
Marysland----	0-9	Loam	CL	A-6, A-7, A-4	0	0-5	95-100	95-100	85-95	50-80	25-50	10-25
	9-20	Loam, clay loam, sandy clay loam	CL, SC	A-6, A-7	0	0-5	90-100	85-100	80-95	45-80	25-45	10-20
	20-60	Stratified fine sand to gravelly coarse sand	SP-SM, SM, GP-GM	A-1, A-2, A-3	0	0-5	70-95	50-90	35-70	5-20	0-15	NP-5
1426:												
Parnell-	0-27	Silty clay loam	CL, CH, OL	A-7	0	0-1	100	100	95-100	85-100	40-55	20-35
	27-45	Clay loam, silty clay loam, silty clay	CL, CH	A-7	0	0-2	100	95-100	90-100	70-100	50-75	30-50
	45-60	Clay loam, silty clay loam, silty clay	CL, CH	A-7	0	0-2	95-100	90-100	80-95	70-95	50-60	30-40
1466: Pits, gravel, and sand	0-6	Extremely gravelly sand	GW-GM, SW-SM	A-1, A-3	0	0-5	25-90	10-65	5-35	0-25	0-15	NP-5
	6-60	Extremely gravelly sand, extremely gravelly coarse sand, gravelly coarse sandy loam	GW-GM, SW-SM	A-1, A-3	0	0-10	25-90	10-65	5-35	0-25	0-15	NP-5
1710:												
Southam	0-5	Silty clay loam	CL, OL, CH	A-7	0	0	100	95-100	90-100	80-100	40-55	20-35
	5-31	Silty clay, clay, silty clay loam	CL, CH	A-7	0	0	100	95-100	90-100	85-100	50-65	30-40
	31-60	Silty clay, silty clay loam, loam	CL, CH, CL-ML	A-6, A-7	0	0-1	100	95-100	85-100	60-100	35-65	15-40

Table 19.--Engineering Index Properties--Continued

(The symbol < means less than; > means more than. Dashes indicate that data were not estimated.)

Map symbol and soil name	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number --				Liquid limit	Plasti-city index
			Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
	Inches				Pct.	Pct.					Pct.	
1782:												
Swenoda-	0-17	Fine sandy loam	SM, SC-SM	A-2, A-4	0	0	100	95-100	70-100	30-50	20-30	5-10
	17-34	Fine sandy loam, sandy loam, loamy fine sand	SC-SM, CL-ML	A-2, A-4	0	0	100	95-100	60-100	30-60	20-30	5-10
	34-60	Silt loam, silty clay loam, loam	CL, CL-ML	A-6, A-7	0	0-5	90-100	90-100	75-100	50-95	30-45	10-20
1884:												
Vallers-	0-8	Loam	CL-ML, CL	A-4, A-6	0-1	0-5	95-100	90-100	80-90	65-80	25-40	10-20
	8-33	Clay loam, silty clay loam, loam	CL	A-6, A-4, A-7	0-1	0-5	95-100	90-100	80-95	50-80	25-45	10-25
	33-60	Loam, clay loam	CL, CL-ML	A-4, A-6	0-1	0-5	95-100	90-100	85-95	60-75	25-45	10-25
Parnell-	0-27	Silty clay loam	CL, CH, OL	A-7	0	0-1	100	100	95-100	85-100	40-55	20-35
	27-45	Clay loam, silty clay loam, silty clay	CL, CH	A-7	0	0-2	100	95-100	90-100	70-100	50-75	30-50
	45-60	Clay loam, silty clay loam, silty clay	CL, CH	A-7	0	0-2	95-100	90-100	80-95	70-95	50-60	30-40
1886:												
Hamerly-	0-10	Loam	CL, CL-ML	A-4, A-6	0	0-5	95-100	90-100	80-95	60-90	25-40	10-20
	10-30	Loam, clay loam	CL, CL-ML	A-4, A-6, A-7	0	0-5	95-100	90-100	80-95	60-75	25-45	10-25
	30-60	Loam, clay loam	CL, CL-ML	A-4, A-6, A-7	0	0-5	95-100	90-100	80-95	60-75	25-45	10-25
Vallers-	0-8	Loam	CL-ML, CL	A-4, A-6	0-1	0-5	95-100	90-100	80-90	65-80	25-40	10-20
	8-33	Clay loam, silty clay loam, loam	CL	A-6, A-4, A-7	0-1	0-5	95-100	90-100	80-95	50-80	25-45	10-25
	33-60	Loam, clay loam	CL, CL-ML	A-4, A-6	0-1	0-5	95-100	90-100	85-95	60-75	25-45	10-25

Table 19.--Engineering Index Properties--Continued

(The symbol < means less than; > means more than. Dashes indicate that data were not estimated.)

Map symbol and soil name	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number --				Liquid limit	Plasti-city index
			Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
	Inches				Pct.	Pct.					Pct.	
1978:												
Water--	--	—	—	—	—	—	—	—	—	—	—	—
2048:												
Wyndmere	0-10	Fine sandy loam	SM, ML, SC-SM, CL-ML	A-2, A-4	0	0	100	100	60-80	30-55	15-25	NP-10
	10-30	Sandy loam, fine sandy loam	SM, ML, SC, SC-SM	A-2, A-4	0	0	100	100	60-90	30-55	15-25	NP-10
	30-60	Fine sand, loamy fine sand, fine sandy loam	SM, ML, SC-SM CL-ML	A-2, A-4	0	0	100	100	60-100	20-55	15-25	NP-10
2151:												
Binford-	0-8	Sandy loam	SM, SC, SC-SM	A-2, A-4	0	0	95-100	95-100	60-95	30-50	15-30	NP-10
	8-18	Sandy loam, coarse sandy loam, loam	SM, ML, SC-SM, CL	A-2, A-4	0	0	95-100	95-100	60-85	30-60	15-30	NP-10
	18-60	Stratified coarse sand to gravelly coarse sand	SM, GP-GM, GM, SP-SM	A-1, A-2	0	5-25	50-95	30-75	15-60	5-30	15-20	NP-5
Coe-----	0-7	Sandy loam	SC, SM, SC-SM, CL-ML	A-2, A-4	0	0-5	95-100	95-100	60-80	30-55	15-30	NP-10
	7-60	Gravelly coarse sand, gravelly loamy coarse sand, very gravelly sand	SM, GP-GM, SP-SM, GM	A-1, A-2, A-3	0	5-25	50-95	30-75	15-60	5-30	15-20	NP-3

Table 19.--Engineering Index Properties--Continued

(The symbol < means less than; > means more than. Dashes indicate that data were not estimated.)

Map symbol and soil name	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number--				Liquid limit	Plasti-city index
			Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
	Inches				Pct.	Pct.					Pct.	
2196:												
Bearden-	0-7	Silt loam	CL-ML, CL	A-4, A-6	0	0	100	100	90-100	70-90	30-35	10-15
	7-22	Silt loam, silty clay loam	CL, CL-ML	A-6, A-7, A-4	0	0	100	100	95-100	80-95	30-45	10-20
	22-60	Silt loam, silty clay loam, loam	CL, CL-ML	A-6, A-7, A-4	0	0	100	100	95-100	80-95	30-45	10-20
Colvin--	0-11	Silt loam	CL	A-6	0	0	100	100	90-100	80-95	20-35	10-20
	11-60	Silt loam, silty clay loam	CL	A-6, A-7	0	0	100	100	90-100	80-95	20-50	10-30
2208:												
Brant-	0-9	Loam	CL, CL-ML	A-4	0	0	90-100	85-95	80-90	60-80	20-30	4-10
ford---	9-15	Loam	CL, CL-ML	A-4, A-6	0	0	90-100	85-95	80-90	60-80	30-35	10-15
	15-60	Stratified loamy sand to very gravelly coarse sand	SM, GP-GM, SP-SM, GM	A-1, A-2, A-3	0	5-25	50-95	30-75	15-60	5-30	15-20	NP-5
Coe------	0-7	Loam	ML, CL-ML, CL	A-4	0	0-5	95-100	95-100	60-80	50-75	15-30	NP-10
	7-60	Gravelly coarse sand, gravelly loamy coarse sand, very gravelly sand	SM, GP-GM, SP-SM, GM	A-1, A-2, A-3	0	5-25	50-95	30-75	15-60	5-30	15-20	NP-3

Table 19.--Engineering Index Properties--Continued

(The symbol < means less than; > means more than. Dashes indicate that data were not estimated.)

Map symbol and soil name	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number --				Liquid limit	Plasti-city index
			Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
	Inches				Pct.	Pct.					Pct.	
2286:												
Aberdeen	0-11	Silty clay loam	CL, CH	A-7	0	0	100	100	95-100	90-100	35-45	15-20
	11-25	Silty clay, clay, silty clay loam	CH, CL	A-7	0	0	100	100	95-100	90-100	45-60	20-35
	25-47	Silty clay loam, silt loam	CL, CH	A-6, A-7	0	0	100	100	95-100	90-100	30-45	10-25
	47-60	Stratified very fine sand to silty clay	CL, CL-ML, CH	A-4, A-6, A-7	0	0	100	100	95-100	85-100	20-55	4-30
Bearden-	0-7	Silt loam	CL-ML, CL	A-4, A-6	0	0	100	100	90-100	70-90	30-35	10-15
	7-12	Silt loam, silty clay loam	CL	A-6, A-7, A-4	0	0	100	100	90-100	80-95	30-45	10-20
	12-22	Silt loam, silty clay loam, loam	CL, CL-ML	A-6, A-7, A-4	0	0	100	100	90-100	80-95	30-45	10-20
	22-60	Silt loam, silty clay loam, silty clay	CL, CH, CL-ML	A-6, A-7	0	0	100	100	90-100	80-95	30-65	10-40
2287:												
Bearden-	0-7	Silt loam	CL-ML, CL	A-4, A-6	0	0	100	100	90-100	70-90	30-35	10-15
	7-12	Silt loam, silty clay loam	CL	A-6, A-7, A-4	0	0	100	100	90-100	80-95	30-45	10-20
	12-22	Silt loam, silty clay loam, loam	CL, CL-ML	A-6, A-7, A-4	0	0	100	100	90-100	80-95	30-45	10-20
	22-60	Silt loam, silty clay loam, silty clay	CL, CH, CL-ML	A-6, A-7	0	0	100	100	90-100	80-95	30-65	10-40
Lindaas-	0-12	Silt loam	CL, CL-ML	A-6	0	0	100	100	95-100	75-95	30-40	15-25
	12-29	Silty clay, clay	CH	A-7	0	0	100	100	95-100	80-95	55-65	30-40
	29-60	Silt loam, silty clay loam, clay loam	CL, CH	A-6, A-7	0	0	100	100	95-100	75-95	40-55	20-35

Table 19.--Engineering Index Properties--Continued

(The symbol < means less than; > means more than. Dashes indicate that data were not estimated.)

Map symbol and soil name	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number --				Liquid limit	Plasti-city index
			Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
	Inches				Pct.	Pct.					Pct.	
2288:												
Brant-	0-9	Loam	CL, CL-ML	A-4	0	0	90-100	85-95	80-90	60-80	20-30	4-10
ford ---	9-15	Loam	CL, CL-ML	A-4, A-6	0	0	90-100	85-95	80-90	60-80	30-35	10-15
	15-60	Stratified loamy sand to very gravelly coarse sand	SM, GP-GM, SP-SM, GM	A-1, A-2, A-3	0	5-25	50-95	30-75	15-60	5-30	15-20	NP-5
Divide--	0-7	Loam	CL, CL-ML	A-4, A-6	0	0-5	95-100	95-100	85-95	60-85	25-35	5-15
	7-25	Loam, clay loam, gravelly loam	CL, CL-ML	A-6, A-7	0	0-5	95-100	75-100	55-90	35-80	30-45	10-25
	25-60	Stratified sand to gravelly sand	SM, GP-GM, SP-SM	A-1, A-3, A-2	0	0-5	25-100	15-100	10-70	5-25	0-15	NP-5
2289:												
Buse----	0-8	Loam	CL, CL-ML	A-4, A-6 A-7	0	0-5	90-100	85-95	70-95	55-90	25-35	10-15
	8-60	Loam, clay loam	CL, CL-ML	A-4, A-6, A-7	0	0-5	90-100	85-100	70-90	55-85	25-45	10-25
Svea----	0-15	Loam	CL, CL-ML	A-4, A-6 A-7	0	0-5	95-100	85-100	80-95	60-90	20-40	5-25
	15-21	Loam, silt loam, clay loam	CL, CL-ML	A-4, A-6, A-7	0	0-5	95-100	85-100	80-100	60-90	20-45	5-25
	21-60	Loam, silt loam, clay loam	CL, CL-ML	A-4, A-6, A-7	0	0-5	95-100	85-100	80-100	60-90	20-50	5-30
Lamoure-	0-10	Silty clay loam	CL, CH, MH, ML	A-7	0	0	100	100	95-100	85-100	40-70	15-35
	10-22	Silty clay loam, silt loam	CL, CH, MH, ML	A-7	0	0	100	100	90-100	60-100	40-70	15-35
	22-42	Silty clay loam, silt loam, loam	CL, ML	A-6, A-7	0	0	95-100	95-100	90-100	60-100	30-70	10-35
	42-60	Stratified sandy loam to silty clay loam	CL, SC	A-6, A-7	0	0	95-100	95-100	70-95	35-90	30-70	10-35

Table 19.--Engineering Index Properties--Continued

(The symbol < means less than; > means more than. Dashes indicate that data were not estimated.)

Map symbol and soil name	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number --				Liquid limit	Plasti-city index
			Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
	Inches				Pct.	Pct.					Pct.	
2290:												
Coe-----	0-7	Sandy loam	SC, SM, SC-SM, CL-ML	A-2, A-4	0	0-5	95-100	95-100	60-80	30-55	15-30	NP-10
	7-60	Gravelly coarse sand, gravelly loamy coarse sand, very gravelly sand	SM, GP-GM, SP-SM, GM	A-1, A-2, A-3	0	5-25	50-95	30-75	15-60	5-30	15-20	NP-3
Binford--	0-8	Sandy loam	SM, SC, SC-SM	A-2, A-4	0	0	95-100	95-100	60-95	30-50	15-30	NP-10
	8-18	Sandy loam, coarse sandy loam, loam	SM, ML, SC-SM, CL	A-2, A-4	0	0	95-100	95-100	60-85	30-60	15-30	NP-10
	18-60	Stratified coarse sand to gravelly coarse sand	SM, GP-GM, GM, SP-SM	A-1, A-2	0	5-25	50-95	30-75	15-60	5-30	15-20	NP-5
2291:												
Great	0-6	Silt loam	CL, CL-ML	A-4, A-6	0	0	100	100	95-100	90-100	30-35	10-15
Bend----	6-13	Silt loam, silty clay loam	CL, CL-ML	A-6, A-7, A-4	0	0	100	100	95-100	85-100	30-45	10-20
	13-30	Silt loam, silty clay loam	CL, CL-ML	A-6, A-7, A-4	0	0	100	100	95-100	85-100	30-45	10-20
	30-60	Stratified silt loam to silty clay loam	CL, CL-ML	A-4, A-6, A-7	0	0	100	100	95-100	85-100	30-45	10-20
Zell----	0-6	Silt loam	CL, ML, CL-ML	A-4, A-6	0	0	100	95-100	85-100	80-100	20-30	5-10
	6-12	Silt loam, very fine sandy loam, loam	CL, ML, CL-ML	A-4, A-6	0	0	100	95-100	85-100	70-100	20-30	5-10
	12-60	Silt loam, very fine sandy loam, loam	ML, CL-ML, CL	A-4, A-6	0	0	100	95-100	85-100	60-100	15-30	NP-10

Table 19.--Engineering Index Properties--Continued

(The symbol < means less than; > means more than. Dashes indicate that data were not estimated.)

Map symbol and soil name	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number --				Liquid limit	Plasticity index
			Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
	Inches				Pct.	Pct.					Pct.	
2292:												
Hamerly-	0-10	Loam	CL, CL-ML	A-4, A-6	0	0-5	95-100	90-100	80-95	60-90	20-40	5-20
	10-30	Loam, clay loam	CL, CL-ML	A-4, A-6, A-7	0	0-5	95-100	90-100	80-95	60-75	20-45	5-25
	30-60	Loam, clay loam	CL, CL-ML	A-4, A-6, A-7	0	0-5	95-100	90-100	75-95	55-75	20-45	5-25
Barnes---	0-6	Loam	CL, CL-ML	A-4, A-6	0	0-5	90-100	85-100	80-100	60-80	25-35	10-20
	6-18	Loam, clay loam	CL, CL-ML	A-4, A-6	0	0-5	90-100	85-100	75-95	55-80	25-45	10-25
	18-25	Loam, clay loam	CL, CL-ML	A-4, A-6	0	0-5	90-100	85-100	75-95	55-80	25-45	10-25
	25-60	Loam, clay loam	CL, CL-ML	A-4, A-6	0	0-5	90-100	85-100	75-95	55-80	25-45	10-25
2293:												
Lamoure-	0-10	Silty clay loam	CL, CH, MH, ML	A-7	0	0	100	100	95-100	85-100	40-70	15-35
	10-22	Silty clay loam, silt loam	CL, CH, MH, ML	A-7	0	0	100	100	90-100	60-100	40-70	15-35
	22-42	Silty clay loam, silt loam, loam	CL, ML	A-6, A-7	0	0	95-100	95-100	90-100	60-100	30-70	10-35
	42-60	Stratified sandy loam to silty clay loam	CL, SC	A-6, A-7	0	0	95-100	95-100	70-95	35-90	30-70	10-35
Colvin--	0-11	Silt loam	CL, CL-ML	A-6, A-4	0	0	100	100	90-100	80-95	30-35	10-15
	11-43	Silt loam, silty clay loam	CL, CL-ML	A-6, A-7, A-4	0	0	100	100	90-100	80-95	30-45	10-20
	43-60	Loam, silt loam, silty clay loam	CL, CL-ML	A-6, A-7, A-4	0	0	100	100	90-100	70-95	30-45	10-20

Table 19.--Engineering Index Properties--Continued

(The symbol < means less than; > means more than. Dashes indicate that data were not estimated.)

Map symbol and soil name	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number --				Liquid limit	Plasti-city index
			Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
	Inches				Pct.	Pct.					Pct.	
2324:												
Wyndmere	0-14	Loam	ML, CL, CL-ML	A-4	0	0	100	100	85-95	50-70	15-25	NP-10
	14-38	Sandy loam, fine sandy loam	CL-ML, SM, SC, SC-SM	A-2, A-4	0	0	100	100	60-90	30-55	15-25	NP-10
	38-44	Fine sand, loamy fine sand, fine sandy loam	CL-ML, SM, SC-SM	A-2, A-4	0	0	100	100	60-100	20-55	15-25	NP-10
	44-60	Silt loam, silty clay loam	CL, CL-ML	A-6, A-7	0	0	100	100	90-100	70-95	30-45	10-20
Tiffany--	0-10	Loam	CL-ML, CL	A-4	0	0	100	100	85-95	50-80	20-30	5-10
	10-51	Fine sandy loam, loam	ML, SM, SC-SM, CL-ML	A-2, A-4	0	0	100	100	60-95	30-80	15-30	NP-10
	51-60	Stratified very fine sandy loam to silty clay loam	CL, CL-ML	A-4, A-6, A-7	0	0	100	100	90-100	60-95	20-45	5-20

Table 20.—Physical Properties of the Soils

(The symbol < means less than; > means more than. Entries under "Erosion factor—T" apply to the entire profile. Entries under "Wind erodibility group and Wind erodibility Index" apply only to the surface layer. Dashes [—] indicate that data were not available or were not estimated.)

Map symbol and soil name	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Shrink-swell potential	Organic matter	Erosion Factors			Wind erodibility group	Wind erodibility index
								K	Kf	T		
	Inches	Pct.	g/cc	In/hr	In/in		Pct.					
118:												
Barnes--	0-6	15-27	1.10-1.50	0.60-2.00	0.20-0.22	Low	3.0-6.0	0.24	0.24	5	6	48
	6-18	18-35	1.20-1.60	0.60-2.00	0.15-0.19	Moderate	2.0-5.0	0.28	0.28			
	18-25	18-35	1.30-1.60	0.20-2.00	0.14-0.19	Moderate	0.0-1.0	0.37	0.37			
	25-60	18-35	1.30-1.60	0.20-2.00	0.14-0.19	Moderate	0.0-0.5	0.37	0.37			
Buse----	0-8	18-27	1.10-1.50	0.20-0.60	0.20-0.24	Low	1.0-3.0	0.28	0.28	5	4L	86
	8-60	18-35	1.30-1.65	0.20-2.00	0.14-0.19	Moderate	0.0-1.0	0.37	0.37			
120:												
Barnes--	0-6	15-27	1.10-1.50	0.60-2.00	0.20-0.22	Low	3.0-6.0	0.24	0.24	5	6	48
	6-18	18-35	1.20-1.60	0.60-2.00	0.15-0.19	Moderate	2.0-5.0	0.28	0.28			
	18-25	18-35	1.30-1.60	0.20-2.00	0.14-0.19	Moderate	0.0-1.0	0.37	0.37			
	25-60	18-35	1.30-1.60	0.20-2.00	0.14-0.19	Moderate	0.0-0.5	0.37	0.37			
Buse----	0-8	18-27	1.10-1.50	0.20-0.60	0.20-0.24	Low	1.0-3.0	0.28	0.28	5	4L	86
	8-60	18-35	1.30-1.65	0.20-2.00	0.14-0.19	Moderate	0.0-1.0	0.37	0.37			
154:												
Barnes--	0-6	15-27	1.10-1.50	0.60-2.00	0.20-0.22	Low	3.0-6.0	0.24	0.24	5	6	48
	6-18	18-35	1.20-1.60	0.60-2.00	0.15-0.19	Moderate	2.0-5.0	0.28	0.28			
	18-25	18-35	1.30-1.60	0.20-2.00	0.14-0.19	Moderate	0.0-1.0	0.37	0.37			
	25-60	18-35	1.30-1.60	0.20-2.00	0.14-0.19	Moderate	0.0-0.5	0.37	0.37			
Svea----	0-15	18-27	1.10-1.30	0.60-2.00	0.20-0.24	Low	4.0-7.0	0.28	0.32	5	6	48
	15-21	18-35	1.20-1.50	0.20-2.00	0.15-0.22	Moderate	2.0-5.0	0.28	0.32			
	21-60	18-35	1.20-1.60	0.20-2.00	0.14-0.19	Moderate	0.0-2.0	0.37	0.43			
167:												
Bearden-	0-7	18-26	1.15-1.30	0.60-2.00	0.20-0.24	Moderate	3.0-7.0	0.28	0.28	5	4L	86
	7-12	18-34	1.30-1.35	0.20-2.00	0.16-0.22	Moderate	0.0-3.0	0.43	0.43			
	12-22	18-34	1.30-1.50	0.20-2.00	0.13-0.22	Moderate	0.0-1.0	0.43	0.43			
	22-60	18-59	1.30-1.55	0.06-2.00	0.13-0.22	Very high	0.0-1.0	0.43	0.43			
314:												
Buse----	0-8	18-27	1.10-1.50	0.20-0.60	0.20-0.24	Low	1.0-3.0	0.28	0.28	5	4L	86
	8-60	18-35	1.30-1.65	0.20-2.00	0.14-0.19	Moderate	0.0-1.0	0.37	0.37			
Barnes--	0-6	15-27	1.10-1.50	0.60-2.00	0.20-0.22	Low	3.0-6.0	0.24	0.24	5	6	48
	6-18	18-35	1.20-1.60	0.60-2.00	0.15-0.19	Moderate	2.0-5.0	0.28	0.28			
	18-25	18-35	1.30-1.60	0.20-2.00	0.14-0.19	Moderate	0.0-1.0	0.37	0.37			
	25-60	18-35	1.30-1.60	0.20-2.00	0.14-0.19	Moderate	0.0-0.5	0.37	0.37			
450:												
Colvin--	0-11	18-26	1.15-1.30	0.60-2.00	0.22-0.24	Low	4.0-7.0	0.28	0.28	5	4L	86
	11-43	18-34	1.20-1.50	0.20-2.00	0.16-0.22	Moderate	1.0-4.0	0.43	0.43			
	43-60	18-34	1.30-1.50	0.20-2.00	0.16-0.22	Moderate	0.5-1.0	0.43	0.43			

Table 20.—Physical Properties of the Soils--Continued

(The symbol < means less than; > means more than. Entries under "Erosion factor—T" apply to the entire profile. Entries under "Wind erodibility group and Wind erodibility Index" apply only to the surface layer. Dashes [—] indicate that data were not available or were not estimated.)

Map symbol and soil name	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Shrink-swell potential	Organic matter	Erosion Factors			Wind erodibility group	Wind erodibility index
								K	Kf	T		
	Inches	Pct.	g/cc	In/hr	In/in		Pct.					
511:												
Divide--	0-7	15-27	1.10-1.40	0.60-2.00	0.20-0.24	Low	2.0-7.0	0.24	0.24	4	4L	86
	7-25	18-35	1.20-1.50	0.20-2.00	0.15-0.19	Moderate	1.0-3.0	0.20	0.32			
	25-60	1-10	1.45-1.65	6.00-20.00	0.02-0.07	Low	0.0-1.0	0.10	0.15			
553:												
Egeland-	0-7	10-18	1.25-1.35	2.00-6.00	0.13-0.18	Low	2.0-4.0	0.20	0.20	5	3	86
	7-26	10-18	1.30-1.45	2.00-6.00	0.12-0.17	Low	0.0-2.0	0.24	0.24			
	26-60	5-10	1.40-1.65	2.00-6.00	0.08-0.12	Low	0.0-0.5	0.17	0.17			
Embden--	0-14	10-18	1.25-1.35	2.00-6.00	0.13-0.18	Low	4.0-7.0	0.20	0.20	5	3	86
	14-28	10-18	1.30-1.60	2.00-6.00	0.12-0.17	Low	1.0-4.0	0.24	0.24			
	28-60	5-18	1.40-1.60	2.00-6.00	0.08-0.16	Low	0.0-1.0	0.24	0.24			
846:												
Great Bend---	0-6	18-26	1.10-1.30	0.60-2.00	0.22-0.24	Low	2.0-4.0	0.28	0.28	5	6	48
	6-13	18-34	1.30-1.35	0.20-2.00	0.16-0.22	Moderate	1.0-3.0	0.32	0.32			
	13-30	18-34	1.30-1.35	0.20-2.00	0.16-0.22	Moderate	0.0-1.0	0.43	0.43			
	30-60	18-34	1.30-1.40	0.20-0.60	0.16-0.22	Moderate	0.0-0.5	0.43	0.43			
Overly--	0-16	10-26	1.20-1.40	0.20-0.60	0.22-0.24	Moderate	4.0-8.0	0.32	0.32	5	6	48
	16-25	18-34	1.20-1.50	0.20-0.60	0.17-0.22	Moderate	0.0-1.0	0.43	0.43			
	25-60	18-59	1.20-1.60	0.06-0.60	0.13-0.22	Moderate	0.0-1.0	0.43	0.43			
871:												
Hamerly-	0-10	18-27	1.30-1.60	0.60-2.00	0.18-0.24	Moderate	4.0-7.0	0.24	0.24	5	4L	86
	10-30	18-35	1.20-1.60	0.60-2.00	0.15-0.19	Moderate	1.0-3.0	0.28	0.28			
	30-60	18-35	1.30-1.60	0.20-0.60	0.14-0.19	Moderate	0.0-0.5	0.37	0.37			
Cres-bard---	0-12	20-26	1.15-1.30	0.60-2.00	0.17-0.20	Low	2.0-5.0	0.32	0.32	5	6	48
	12-22	35-50	1.20-1.35	0.06-0.60	0.11-0.14	High	0.5-2.0	0.32	0.32			
	22-29	35-50	1.20-1.35	0.06-0.60	0.11-0.15	High	0.0-0.5	0.32	0.32			
	29-60	25-35	1.40-1.60	0.20-0.60	0.16-0.20	Moderate	0.0-0.5	0.32	0.32			
883:												
Hamerly-	0-10	18-27	1.30-1.60	0.60-2.00	0.18-0.24	Moderate	4.0-7.0	0.24	0.24	5	4L	86
	10-30	18-35	1.20-1.60	0.60-2.00	0.15-0.19	Moderate	1.0-3.0	0.28	0.28			
	30-60	18-35	1.30-1.60	0.20-0.60	0.14-0.19	Moderate	0.0-0.5	0.37	0.37			
Tonka---	0-18	18-27	1.10-1.30	0.60-2.00	0.20-0.24	Low	5.0-10	0.37	0.37	5	6	48
	18-42	35-45	1.40-1.65	0.06-0.20	0.14-0.20	High	1.0-3.0	0.43	0.43			
	42-60	18-39	1.40-1.70	0.20-2.00	0.14-0.19	Moderate	0.0-1.0	0.37	0.37			
Parnell-	0-27	27-40	1.10-1.30	0.20-0.60	0.18-0.22	Moderate	6.0-10	0.37	0.37	5	7	38
	27-45	35-60	1.20-1.40	0.06-0.20	0.13-0.19	High	3.0-5.0	0.28	0.28			
	45-60	35-45	1.30-1.50	0.06-0.20	0.11-0.19	High	0.5-1.0	0.28	0.28			
926:												
Hecla---	0-9	2-10	1.10-1.35	2.00-20.00	0.10-0.12	Low	1.0-3.0	0.17	0.17	5	2	134
	9-33	2-10	1.30-1.50	2.00-20.00	0.06-0.13	Low	1.0-3.0	0.17	0.17			
	33-60	3-8	1.35-1.60	2.00-20.00	0.05-0.12	Low	0.0-1.0	0.17	0.17			

Table 20.—Physical Properties of the Soils--Continued

(The symbol < means less than; > means more than. Entries under "Erosion factor—T" apply to the entire profile. Entries under "Wind erodibility group and Wind erodibility Index" apply only to the surface layer. Dashes [—] indicate that data were not available or were not estimated.)

Map symbol and soil name	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Shrink-swell potential	Organic matter	Erosion Factors			Wind erodibility group	Wind erodibility index
								K	Kf	T		
	Inches	Pct.	g/cc	In/hr	In/in		Pct.					
966:												
Hegne---	0-7	40-60	1.05-1.30	0.06-0.20	0.09-0.11	Very high	4.0-8.0	0.28	0.28	5	4	86
	7-32	40-60	1.30-1.40	0.06-0.20	0.09-0.11	Very high	0.0-4.0	0.28	0.28			
	32-60	40-60	1.30-1.50	0.06-0.20	0.08-0.09	Very high	0.0-1.0	0.28	0.28			
971:												
Hegne---	0-7	40-60	1.05-1.30	0.06-0.20	0.15-0.18	Very high	4.0-8.0	0.28	0.28	5	4	86
	7-12	40-60	1.30-1.35	0.06-0.20	0.14-0.17	Very high	1.0-4.0	0.28	0.28			
	12-32	40-60	1.30-1.40	0.06-0.20	0.14-0.20	Very high	0.5-2.0	0.28	0.28			
	32-60	40-60	1.30-1.50	0.06-0.20	0.13-0.20	Very high	0.0-1.0	0.28	0.28			
Fargo---	0-8	40-60	1.10-1.30	0.06-0.20	0.15-0.18	High	4.0-10	0.32	0.32	5	4	86
	8-18	40-60	1.20-1.50	0.06-0.20	0.14-0.17	High	2.0-7.0	0.32	0.32			
	18-60	40-60	1.20-1.50	0.06-0.20	0.14-0.17	High	1.0-5.0	0.32	0.32			
1221:												
Mad-dock---	0-10	2-10	1.20-1.40	2.00-20.00	0.10-0.12	Low	1.0-2.0	0.17	0.17	5	2	134
	10-60	2-8	1.30-1.50	2.00-20.00	0.05-0.12	Low	0.0-0.5	0.17	0.17			
Hecla---	0-9	2-10	1.10-1.35	2.00-20.00	0.10-0.12	Low	1.0-3.0	0.17	0.17	5	2	134
	9-33	2-10	1.30-1.50	2.00-20.00	0.06-0.13	Low	1.0-3.0	0.17	0.17			
	33-60	3-8	1.35-1.60	2.00-20.00	0.05-0.12	Low	0.0-1.0	0.17	0.17			
1267:												
Marys-land---	0-9	18-35	1.10-1.30	0.60-2.00	0.17-0.24	Moderate	5.0-8.0	0.28	0.28	4	4L	86
	9-20	18-35	1.35-1.50	0.20-2.00	0.15-0.19	Moderate	1.0-3.0	0.28	0.28			
	20-60	1-5	1.45-1.65	6.00-20.00	0.02-0.07	Low	0.0-0.5	0.10	0.10			
1426:												
Parnell-	0-27	27-40	1.10-1.30	0.20-0.60	0.18-0.22	Moderate	6.0-10	0.37	0.37	5	7	38
	27-45	35-60	1.20-1.40	0.06-0.20	0.13-0.19	High	3.0-5.0	0.28	0.28			
	45-60	35-45	1.30-1.50	0.06-0.20	0.11-0.19	High	0.5-1.0	0.28	0.28			
1466:												
Pits, gravel and sand---	0-6	5-15	1.20-1.60	6.00-20.00	0.01-0.04	Low	0.5-1.0	0.10	0.20	5	8	—
	6-60	0-15	1.20-1.60	6.00-20.00	0.01-0.04	Low	0.0-0.5	0.10	0.17			
1710:												
Southam-	0-5	27-40	1.10-1.40	0.20-0.60	0.18-0.23	Moderate	5.0-20	0.37	0.37	5	4L	86
	5-31	35-50	1.20-1.50	0.06-0.20	0.14-0.20	High	1.0-10	0.28	0.28			
	31-60	18-50	1.20-1.50	0.06-0.60	0.13-0.17	High	0.0-3.0	0.28	0.28			
1782:												
Swenoda-	0-17	10-20	1.10-1.35	2.00-6.00	0.13-0.18	Low	3.0-7.0	0.20	0.20	5	3	86
	17-34	10-18	1.30-1.45	2.00-6.00	0.10-0.17	Low	1.0-3.0	0.20	0.20			
	34-60	20-35	1.35-1.65	0.20-2.00	0.16-0.22	Moderate	0.0-1.0	0.37	0.37			

Table 20.—Physical Properties of the Soils--Continued

(The symbol < means less than; > means more than. Entries under "Erosion factor—T" apply to the entire profile. Entries under "Wind erodibility group and Wind erodibility Index" apply only to the surface layer. Dashes [—] indicate that data were not available or were not estimated.)

Map symbol and soil name	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Shrink-swell potential	Organic matter	Erosion Factors			Wind erodibility group	Wind erodibility index
								K	Kf	T		
	Inches	Pct.	g/cc	In/hr	In/in		Pct.					
1884:												
Vallers-	0-8	18-27	1.10-1.40	0.60-2.00	0.14-0.16	Low	5.0-8.0	0.24	0.24	5	4L	86
	8-33	18-35	1.20-1.50	0.20-2.00	0.10-0.13	Moderate	1.0-3.0	0.28	0.28			
	33-60	18-35	1.30-1.60	0.20-2.00	0.11-0.13	Moderate	0.0-1.0	0.37	0.37			
Parnell--	0-27	27-40	1.10-1.30	0.20-0.60	0.18-0.22	Moderate	6.0-10	0.37	0.37	5	7	38
	27-45	35-60	1.20-1.40	0.06-0.20	0.13-0.19	High	3.0-5.0	0.28	0.28			
	45-60	35-45	1.30-1.50	0.06-0.20	0.11-0.19	High	0.5-1.0	0.28	0.28			
1886:												
Hamerly-	0-10	18-27	1.10-1.30	0.60-2.00	0.13-0.16	Low	3.0-6.0	0.28	0.28	5	4L	86
	10-30	18-35	1.20-1.50	0.20-2.00	0.10-0.13	Moderate	1.0-3.0	0.28	0.28			
	30-60	18-35	1.20-1.60	0.20-2.00	0.10-0.13	Moderate	0.0-1.0	0.37	0.37			
Vallers-	0-8	18-27	1.10-1.40	0.60-2.00	0.14-0.16	Low	5.0-8.0	0.24	0.24	5	4L	86
	8-33	18-35	1.20-1.50	0.20-2.00	0.10-0.13	Moderate	1.0-3.0	0.28	0.28			
	33-60	18-35	1.30-1.60	0.20-2.00	0.11-0.13	Moderate	0.0-1.0	0.37	0.37			
1978:												
Water---	—	—	—	--	—	—	--	--	--	—	—	—
2048:												
Wynd-mere---	0-10	5-15	1.10-1.35	2.00-6.00	0.13-0.18	Low	5.0-8.0	0.20	0.20	5	3	86
	10-30	3-15	1.30-1.50	2.00-6.00	0.12-0.17	Low	1.0-5.0	0.24	0.24			
	30-60	3-15	1.30-1.70	2.00-20.00	0.05-0.16	Low	0.0-1.0	0.24	0.24			
2151:												
Binford-	0-8	6-18	1.10-1.35	2.00-6.00	0.13-0.15	Low	2.0-5.0	0.20	0.20	3	3	86
	8-18	6-18	1.30-1.50	2.00-6.00	0.12-0.19	Low	1.0-2.0	0.24	0.24			
	18-60	2-8	1.50-1.65	6.00-20.00	0.02-0.04	Low	0.0-0.5	0.10	0.20			
Coe-----	0-7	6-18	1.25-1.35	2.00-6.00	0.13-0.15	Low	2.0-4.0	0.20	0.20	2	3	86
	7-60	2-8	1.35-1.65	6.00-20.00	0.02-0.04	Low	0.0-0.5	0.10	0.43			
2196:												
Bearden-	0-7	18-26	1.15-1.30	0.60-2.00	0.14-0.15	Moderate	3.0-7.0	0.28	0.28	5	4L	86
	7-22	18-34	1.30-1.45	0.20-2.00	0.10-0.14	Moderate	0.0-3.0	0.43	0.43			
	22-60	18-34	1.30-1.60	0.20-2.00	0.10-0.14	Moderate	0.0-1.0	0.43	0.43			
Colvin--	0-11	18-26	1.20-1.50	0.60-2.00	0.15-0.17	Moderate	4.0-7.0	0.37	0.37	5	4L	86
	11-60	18-34	1.30-1.50	0.06-2.00	0.11-0.15	Moderate	0.0-5.0	0.37	0.37			
2208:												
Brant-ford---	0-9	10-19	1.10-1.30	0.60-2.00	0.20-0.22	Low	3.0-6.0	0.28	0.32	3	5	56
	9-15	18-27	1.25-1.40	0.60-2.00	0.17-0.19	Low	1.0-3.0	0.28	0.32			
	15-60	2-8	1.35-1.65	6.00-20.00	0.02-0.04	Low	0.0-0.5	0.10	0.43			
Coe-----	0-7	6-18	1.15-1.30	0.60-2.00	0.20-0.22	Low	2.0-4.0	0.28	0.28	2	5	56
	7-60	2-8	1.35-1.65	6.00-20.00	0.02-0.04	Low	0.0-0.5	0.10	0.43			

Table 20.—Physical Properties of the Soils--Continued

(The symbol < means less than; > means more than. Entries under "Erosion factor—T" apply to the entire profile. Entries under "Wind erodibility group and Wind erodibility Index" apply only to the surface layer. Dashes [—] indicate that data were not available or were not estimated.)

Map symbol and soil name	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Shrink-swell potential	Organic matter	Erosion Factors			Wind erodibility group	Wind erodibility index
								K	Kf	T		
	Inches	Pct.	g/cc	In/hr	In/in		Pct.					
2286:												
Aberdeen---	0-11	27-34	1.05-1.30	0.20-0.60	0.18-0.23	Moderate	3.0-6.0	0.28	0.28	5	7	38
	11-25	35-55	1.30-1.40	0.06-0.20	0.14-0.20	High	1.0-3.0	0.32	0.32			
	25-47	20-39	1.30-1.40	0.02-2.00	0.16-0.22	Moderate	0.0-1.0	0.43	0.43			
	47-60	10-45	1.30-1.45	0.06-2.00	0.16-0.18	High	0.0-0.5	0.43	0.43			
Bearden-	0-7	18-26	1.15-1.30	0.60-2.00	0.20-0.24	Moderate	3.0-7.0	0.28	0.28	5	4L	86
	7-12	18-34	1.30-1.35	0.20-2.00	0.16-0.22	Moderate	0.0-3.0	0.43	0.43			
	12-22	18-34	1.30-1.50	0.20-2.00	0.13-0.22	Moderate	0.0-1.0	0.43	0.43			
	22-60	18-59	1.30-1.55	0.06-2.00	0.13-0.22	Very high	0.0-1.0	0.43	0.43			
2287:												
Bearden-	0-7	18-26	1.15-1.30	0.60-2.00	0.20-0.24	Moderate	3.0-7.0	0.28	0.28	5	4L	86
	7-12	18-34	1.30-1.35	0.20-2.00	0.16-0.22	Moderate	0.0-3.0	0.43	0.43			
	12-22	18-34	1.30-1.50	0.20-2.00	0.13-0.22	Moderate	0.0-1.0	0.43	0.43			
	22-60	18-59	1.30-1.55	0.06-2.00	0.13-0.22	Very high	0.0-1.0	0.43	0.43			
Lindaas-	0-12	18-26	1.15-1.30	0.60-2.00	0.22-0.24	Low	4.0-7.0	0.28	0.28	5	6	48
	12-29	40-50	1.20-1.40	0.06-0.20	0.14-0.17	Very high	0.0-4.0	0.32	0.32			
	29-60	25-40	1.20-1.50	0.20-2.00	0.15-0.22	High	0.0-2.0	0.43	0.43			
2288:												
Brantford---	0-9	10-19	1.10-1.30	0.60-2.00	0.20-0.22	Low	3.0-6.0	0.28	0.32	3	5	56
	9-15	18-27	1.25-1.40	0.60-2.00	0.17-0.19	Low	1.0-3.0	0.28	0.32			
	15-60	2-8	1.35-1.65	6.00-20.00	0.02-0.04	Low	0.0-0.5	0.10	0.43			
Divide--	0-7	15-27	1.10-1.40	0.60-2.00	0.20-0.24	Low	2.0-7.0	0.24	0.24	4	4L	86
	7-25	18-35	1.20-1.50	0.20-2.00	0.15-0.19	Moderate	1.0-3.0	0.20	0.32			
	25-60	1-10	1.45-1.65	6.00-20.00	0.02-0.07	Low	0.0-1.0	0.10	0.15			
2289:												
Buse----	0-8	18-27	1.10-1.50	0.20-0.60	0.20-0.24	Low	1.0-3.0	0.28	0.28	5	4L	86
	8-60	18-35	1.30-1.65	0.20-2.00	0.14-0.19	Moderate	0.0-1.0	0.37	0.37			
Svea----	0-15	18-26	1.10-1.30	0.60-2.00	0.20-0.24	Low	5.0-8.0	0.28	0.32	5	6	48
	15-21	18-28	1.20-1.50	0.60-2.00	0.17-0.22	Moderate	--	0.28	0.32			
	21-60	18-28	1.20-1.50	0.20-2.00	0.14-0.19	Moderate	--	0.37	0.43			
Lamoure-	0-10	27-34	1.15-1.25	0.20-2.00	0.19-0.22	Moderate	4.0-8.0	0.28	0.28	5	4L	86
	10-22	20-34	1.20-1.35	0.20-2.00	0.17-0.20	Moderate	1.0-3.0	0.32	0.32			
	22-42	20-34	1.20-1.35	0.20-2.00	0.17-0.20	Moderate	0.5-1.0	0.43	0.43			
	42-60	20-34	1.25-1.40	0.20-2.00	0.09-0.18	Moderate	0.0-0.5	0.28	0.28			
2290:												
Coe-----	0-7	6-18	1.25-1.35	2.00-6.00	0.13-0.15	Low	2.0-4.0	0.20	0.20	2	3	86
	7-60	2-8	1.35-1.65	6.00-20.00	0.02-0.04	Low	0.0-0.5	0.10	0.43			
Binford-	0-8	6-18	1.10-1.35	2.00-6.00	0.13-0.15	Low	2.0-5.0	0.20	0.20	3	3	86
	8-18	6-18	1.30-1.50	2.00-6.00	0.12-0.19	Low	1.0-2.0	0.24	0.24			
	18-60	2-8	1.50-1.65	6.00-20.00	0.02-0.04	Low	0.0-0.5	0.10	0.20			

Table 20.—Physical Properties of the Soils--Continued

(The symbol < means less than; > means more than. Entries under "Erosion factor—T" apply to the entire profile. Entries under "Wind erodibility group and Wind erodibility Index" apply only to the surface layer. Dashes [—] indicate that data were not available or were not estimated.)

Map symbol and soil name	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Shrink-swell potential	Organic matter	Erosion Factors			Wind erodibility group	Wind erodibility index
								K	Kf	T		
	Inches	Pct.	g/cc	In/hr	In/in		Pct.					
2291:												
Great Bend---	0-6	18-26	1.10-1.30	0.60-2.00	0.22-0.24	Low	2.0-4.0	0.28	0.28	5	6	48
	6-13	18-34	1.30-1.35	0.20-2.00	0.16-0.22	Moderate	1.0-3.0	0.32	0.32			
	13-30	18-34	1.30-1.35	0.20-2.00	0.16-0.22	Moderate	0.0-1.0	0.43	0.43			
	30-60	18-34	1.30-1.40	0.20-0.60	0.16-0.22	Moderate	0.0-0.5	0.43	0.43			
Zell----	0-6	10-18	1.15-1.30	0.60-2.00	0.20-0.24	Low	2.0-4.0	0.32	0.32	5	4L	86
	6-12	10-18	1.30-1.35	0.60-2.00	0.16-0.22	Low	0.5-2.0	0.43	0.43			
	12-60	5-18	1.30-1.50	0.60-2.00	0.15-0.22	Low	0.0-0.5	0.43	0.43			
2292:												
Hamerly-	0-10	18-27	1.30-1.60	0.60-2.00	0.18-0.24	Moderate	4.0-7.0	0.24	0.24	5	4L	86
	10-30	18-35	1.20-1.60	0.60-2.00	0.15-0.19	Moderate	1.0-3.0	0.28	0.28			
	30-60	18-35	1.30-1.60	0.20-0.60	0.14-0.19	Moderate	0.0-0.5	0.37	0.37			
Barnes--	0-6	15-27	1.10-1.50	0.60-2.00	0.20-0.22	Low	3.0-6.0	0.24	0.24	5	6	48
	6-18	18-35	1.20-1.60	0.60-2.00	0.15-0.19	Moderate	2.0-5.0	0.28	0.28			
	18-25	18-35	1.30-1.60	0.20-2.00	0.14-0.19	Moderate	0.0-1.0	0.37	0.37			
	25-60	18-35	1.30-1.60	0.20-2.00	0.14-0.19	Moderate	0.0-0.5	0.37	0.37			
2293:												
Lamoure-	0-10	27-34	1.15-1.25	0.20-2.00	0.19-0.22	Moderate	4.0-8.0	0.28	0.28	5	4L	86
	10-22	20-34	1.20-1.35	0.20-2.00	0.17-0.20	Moderate	1.0-3.0	0.32	0.32			
	22-42	20-34	1.20-1.35	0.20-2.00	0.17-0.20	Moderate	0.5-1.0	0.43	0.43			
	42-60	20-34	1.25-1.40	0.20-2.00	0.09-0.18	Moderate	0.0-0.5	0.28	0.28			
Colvin--	0-11	18-26	1.10-1.30	0.60-2.00	0.22-0.24	Low	4.0-7.0	0.28	0.28	5	4L	86
	11-43	18-34	1.30-1.50	0.20-2.00	0.16-0.22	Moderate	1.0-4.0	0.43	0.43			
	43-60	18-34	1.30-1.50	0.20-2.00	0.16-0.22	Moderate	0.5-1.0	0.43	0.43			
2324:												
Wynd-mere---	0-14	5-15	1.10-1.30	0.60-2.00	0.20-0.24	Low	4.0-8.0	0.24	0.24	5	4L	86
	14-38	3-15	1.30-1.50	2.00-6.00	0.12-0.17	Low	1.0-4.0	0.24	0.24			
	38-44	3-15	1.30-1.50	2.00-20.00	0.06-0.17	Low	0.0-1.0	0.24	0.24			
	44-60	18-35	1.30-1.60	0.20-2.00	0.16-0.22	Moderate	0.0-1.0	0.43	0.43			
Tiffany-	0-10	10-18	1.15-1.30	0.60-2.00	0.20-0.24	Low	4.0-8.0	0.28	0.28	5	5	56
	10-51	5-18	1.30-1.60	2.00-6.00	0.15-0.19	Low	1.0-4.0	0.28	0.28			
	51-60	10-35	1.30-1.60	0.20-6.00	0.15-0.22	Moderate	0.0-1.0	0.43	0.43			

Table 21.—Chemical Properties of the Soils

Dashes (—) indicate that data were not available or were not estimated.

Map symbol and soil name	Depth	Clay	Cation-exchange capacity	Soil reaction (pH)	Calcium carbonate	Gypsum	Salinity	Sodium adsorption ratio
	Inches	Pct.	meq/100g		Pct.	Pct.	Pct.	
118:								
Barnes	0-6	15-27	10.0-30.0	5.6-7.8	—	—	0-2	—
	6-18	18-35	10.0-30.0	6.1-7.8	0-3	—	0-4	—
	18-25	18-35	5.0-25.0	7.4-8.4	10-30	0-1	0-4	—
	25-60	18-35	5.0-25.0	7.4-8.4	10-30	0-1	0-4	0-2
Buse	0-8	18-27	10.0-30.0	6.6-8.4	1-10	—	—	—
	8-60	18-35	5.0-25.0	7.4-8.4	10-30	0-1	0-4	0-2
120:								
Barnes	0-6	15-27	10.0-30.0	5.6-7.8	—	—	0-2	—
	6-18	18-35	10.0-30.0	6.1-7.8	0-3	—	0-4	—
	18-25	18-35	5.0-25.0	7.4-8.4	10-30	0-1	0-4	—
	25-60	18-35	5.0-25.0	7.4-8.4	10-30	0-1	0-4	0-2
Buse	0-8	18-27	10.0-30.0	6.6-8.4	1-10	—	—	—
	8-60	18-35	5.0-25.0	7.4-8.4	10-30	0-1	0-4	0-2
154:								
Barnes	0-6	15-27	10.0-30.0	5.6-7.8	—	—	0-2	—
	6-18	18-35	10.0-30.0	6.1-7.8	0-3	—	0-4	—
	18-25	18-35	5.0-25.0	7.4-8.4	10-30	0-1	0-4	—
	25-60	18-35	5.0-25.0	7.4-8.4	10-30	0-1	0-4	0-2
Svea	0-15	18-27	15.0-30.0	6.1-7.8	—	—	—	—
	15-21	18-35	10.0-30.0	6.6-7.8	0-3	—	—	—
	21-60	18-35	10.0-25.0	7.4-8.4	3-15	0-1	0-4	0-2
167:								
Bearden	0-7	18-26	15.0-30.0	7.4-8.4	0-10	0-1	0-4	0-2
	7-12	18-34	5.0-25.0	7.4-8.4	10-45	0-1	0-4	0-3
	12-22	18-34	5.0-20.0	7.4-8.4	5-20	0-5	0-4	0-10
	22-60	18-59	5.0-35.0	7.4-8.4	5-20	0-5	0-8	0-10
314:								
Buse	0-8	18-27	10.0-30.0	6.6-8.4	1-10	—	—	—
	8-60	18-35	5.0-25.0	7.4-8.4	10-30	0-1	0-4	0-2
Barnes	0-6	15-27	10.0-30.0	5.6-7.8	—	—	0-2	—
	6-18	18-35	10.0-30.0	6.1-7.8	0-3	—	0-4	—
	18-25	18-35	5.0-25.0	7.4-8.4	10-30	0-1	0-4	—
	25-60	18-35	5.0-25.0	7.4-8.4	10-30	0-1	0-4	0-2
450:								
Colvin	0-11	18-26	15.0-30.0	6.6-8.4	0-10	0-1	0-4	0-2
	11-43	18-34	5.0-30.0	7.4-8.4	10-45	0-1	0-4	0-3
	43-60	18-34	5.0-20.0	7.4-8.4	5-20	0-5	0-4	0-10
511:								
Divide	0-7	15-27	10.0-30.0	7.4-8.4	1-15	—	—	—
	7-25	18-35	10.0-30.0	7.4-8.4	15-35	0-1	0-2	—
	25-60	1-10	2.0-10.0	7.4-8.4	10-30	—	—	—

Table 21.—Chemical Properties of the Soils--Continued

Dashes (—) indicate that data were not available or were not estimated.

Map symbol and soil name	Depth	Clay	Cation-exchange capacity	Soil reaction (pH)	Calcium carbonate	Gypsum	Salinity	Sodium adsorption ratio
	Inches	Pct.	meq/100g		Pct.	Pct.	Pct.	
553:								
Egeland--------	0-7	10-18	10.0-15.0	5.6-7.3	—-	—-	0-2	—-
	7-26	10-18	5.0-15.0	6.1-7.8	—-	—-	0-2	—-
	26-60	5-10	2.0-5.0	6.6-8.4	0-10	0-1	0-2	—-
Embden---------	0-14	10-18	10.0-25.0	6.6-7.3	—-	—-	—-	—-
	14-28	10-18	5.0-20.0	6.6-7.8	—-	—-	—-	—-
	28-60	5-18	2.0-15.0	6.6-8.4	0-15	—-	0-2	—-
846:								
Great Bend-----	0-6	18-26	10.0-25.0	6.1-7.8	—-	—-	0-2	—-
	6-13	18-34	10.0-25.0	6.6-8.4	—-	—-	0-2	—-
	13-30	18-34	5.0-20.0	7.4-8.4	0-10	—-	0-2	—-
	30-60	18-34	5.0-20.0	7.4-8.4	0-10	—-	0-4	—-
Overly---------	0-16	10-26	20.0-40.0	6.6-7.8	—-	—-	—-	—-
	16-25	18-34	15.0-30.0	6.6-8.4	0-10	0-2	0-2	—-
	25-60	18-59	15.0-30.0	7.9-8.4	10-20	0-2	0-4	—-
871:								
Hamerly--------	0-10	18-27	15.0-30.0	6.6-8.4	0-10	—-	0-2	—-
	10-30	18-35	10.0-20.0	7.4-8.4	15-35	0-2	0-4	0-2
	30-60	18-35	10.0-20.0	7.4-8.4	10-30	0-2	0-4	0-2
Cresbard ------	0-12	20-26	20.0-25.0	5.6-7.3	—-	—-	0-2	—-
	12-22	35-50	20.0-30.0	5.6-7.8	—-	—-	2-4	1-10
	22-29	35-50	15.0-25.0	6.1-8.4	10-20	1-5	2-4	5-15
	29-60	25-35	15.0-20.0	7.4-9.0	10-20	1-5	2-8	5-15
883:								
Hamerly--------	0-10	18-27	15.0-30.0	6.6-8.4	0-10	—-	0-2	—-
	10-30	18-35	10.0-20.0	7.4-8.4	15-35	0-2	0-4	0-2
	30-60	18-35	10.0-20.0	7.4-8.4	10-30	0-2	0-4	0-2
Tonka----------	0-18	18-27	15.0-35.0	5.6-7.8	—-	—-	—-	—-
	18-42	35-45	15.0-35.0	5.6-7.8	0-1	0-1	0-2	0-1
	42-60	18-39	10.0-25.0	6.6-8.4	5-20	0-2	0-4	0-2
Parnell--------	0-27	27-40	25.0-45.0	6.1-7.8	—-	—-	—-	—-
	27-45	35-60	20.0-45.0	6.1-7.8	—-	—-	—-	—-
	45-60	35-45	15.0-30.0	6.6-8.4	0-3	0-2	—-	—-
926:								
Hecla----------	0-9	2-10	3.0-10.0	6.1-7.8	0-3	—-	—-	—-
	9-33	2-10	3.0-10.0	6.1-7.8	0-3	—-	—-	—-
	33-60	3-8	1.0-8.0	6.1-8.4	0-10	—-	—-	—-
966:								
Hegne----------	0-7	40-60	30.0-65.0	7.4-9.0	10-20	—-	4-16	0-2
	7-32	40-60	25.0-55.0	7.4-9.0	15-30	0-3	4-16	0-5
	32-60	40-60	25.0-50.0	7.4-9.0	10-20	0-3	4-16	0-10

Table 21.—Chemical Properties of the Soils--Continued

Dashes (—) indicate that data were not available or were not estimated.

Map symbol and soil name	Depth	Clay	Cation-exchange capacity	Soil reaction (pH)	Calcium carbonate	Gypsum	Salinity	Sodium adsorption ratio
	Inches	Pct.	meq/100g		Pct.	Pct.	Pct.	
971:								
Hegne----------	0-7	40-60	30.0-65.0	7.4-8.4	10-20	——	——	——
	7-12	40-60	25.0-55.0	7.4-8.4	15-30	0-1	0-4	0-2
	12-32	40-60	25.0-50.0	7.4-8.4	15-30	0-3	0-4	0-2
	32-60	40-60	25.0-50.0	7.4-8.4	10-20	0-3	0-4	0-2
Fargo----------	0-8	40-60	30.0-60.0	6.6-7.8	0-10	——	0-2	——
	8-18	40-60	25.0-50.0	6.6-8.4	0-15	——	0-2	——
	18-60	40-60	20.0-45.0	7.9-8.4	5-15	0-3	0-2	——
1221:								
Maddock--------	0-10	2-10	3.0-10.0	6.6-7.8	0-3	——	0-2	——
	10-60	2-8	1.0-8.0	6.6-8.4	0-10	——	0-2	——
Hecla----------	0-9	2-10	3.0-10.0	6.1-7.8	0-3	——	——	——
	9-33	2-10	3.0-10.0	6.1-7.8	0-3	——	——	——
	33-60	3-8	1.0-8.0	6.1-8.4	0-10	——	——	——
1267:								
Marysland------	0-9	18-35	15.0-35.0	7.9-8.4	1-15	——	——	——
	9-20	18-35	10.0-25.0	7.9-8.4	15-35	0-3	0-2	——
	20-60	1-5	2.0-10.0	7.9-8.4	5-20	——	——	——
1426:								
Parnell--------	0-27	27-40	25.0-45.0	6.1-7.8	——	——	——	——
	27-45	35-60	20.0-45.0	6.1-7.8	——	——	——	——
	45-60	35-45	15.0-30.0	6.6-8.4	0-3	0-2	——	——
1466:								
Pits, gravel and sand------	0-6	5-15	2.0-12.0	6.6-8.4	0-3	——	——	——
	6-60	0-15	1.0-10.0	6.6-8.4	5-20	——	——	——
1710:								
Southam--------	0-5	27-40	25.0-50.0	6.6-8.4	0-10	0-1	2-8	0-2
	5-31	35-50	25.0-65.0	6.6-8.4	3-25	0-1	2-8	0-2
	31-60	18-50	15.0-45.0	7.4-8.4	10-30	0-5	2-8	0-2
1782:								
Swenoda--------	0-17	10-20	10.0-25.0	6.1-7.3	——	——	0-2	——
	17-34	10-18	5.0-15.0	6.6-7.8	——	——	0-2	——
	34-60	20-35	2.0-25.0	7.4-8.4	10-30	0-1	0-4	0-2
1884:								
Vallers--------	0-8	18-27	15.0-30.0	7.4-8.4	5-10	0-1	4-16	0-3
	8-33	18-35	10.0-25.0	7.4-8.4	15-35	0-3	4-16	0-5
	33-60	18-35	10.0-20.0	7.4-8.4	15-30	0-3	4-16	0-10
Parnell--------	0-27	27-40	25.0-45.0	6.1-7.8	——	——	——	——
	27-45	35-60	20.0-45.0	6.1-7.8	——	——	——	——
	45-60	35-45	15.0-30.0	6.6-8.4	0-3	0-2	——	——

Table 21.—Chemical Properties of the Soils--Continued

Dashes (—) indicate that data were not available or were not estimated.

Map symbol and soil name	Depth	Clay	Cation-exchange capacity	Soil reaction (pH)	Calcium carbonate	Gypsum	Salinity	Sodium adsorption ratio
	Inches	Pct.	meq/100g		Pct.	Pct.	Pct.	
1886:								
Hamerly---------	0-10	18-27	15.0-30.0	7.4-8.4	1-15	0-3	4-16	—-
	10-30	18-35	10.0-30.0	7.4-8.4	15-35	0-5	4-16	0-2
	30-60	18-35	10.0-25.0	7.4-8.4	10-30	0-5	4-16	0-4
Vallers---------	0-8	18-27	15.0-30.0	7.4-8.4	5-10	0-1	4-16	0-3
	8-33	18-35	10.0-25.0	7.4-8.4	15-35	0-3	4-16	0-5
	33-60	18-35	10.0-20.0	7.4-8.4	15-30	0-3	4-16	0-10
1978:								
Water-----------	—	—	—	—	—-	—-	—-	—-
2048:								
Wyndmere --------	0-10	5-15	10.0-25.0	6.6-8.4	10-20	0-1	—-	0-1
	10-30	3-15	3.0-20.0	7.4-8.4	15-35	0-1	0-2	0-1
	30-60	3-15	2.0-10.0	7.4-8.4	5-20	0-1	0-2	0-3
2151:								
Binford---------	0-8	6-18	5.0-20.0	5.6-7.8	—-	—-	—-	—-
	8-18	6-18	5.0-15.0	5.6-8.4	0-1	—-	—-	—-
	18-60	2-8	1.0-5.0	7.4-8.4	5-20	—-	—-	—-
Coe-------------	0-7	6-18	5.0-15.0	6.6-7.8	0-5	—-	—-	—-
	7-60	2-8	1.0-5.0	7.4-8.4	5-20	—-	—-	—-
2196:								
Bearden---------	0-7	18-26	15.0-30.0	7.4-7.8	0-10	0-1	4-16	0-2
	7-22	18-34	5.0-25.0	7.4-8.4	10-45	0-5	4-16	0-3
	22-60	18-34	5.0-20.0	7.4-8.4	5-20	0-5	4-16	0-10
Colvin----------	0-11	18-26	25.0-35.0	7.4-8.4	0-10	0-1	4-16	0-2
	11-60	18-34	10.0-25.0	7.4-8.4	5-45	0-5	4-16	0-10
2208:								
Brantford-------	0-9	10-19	10.0-25.0	6.1-7.8	—-	—-	—-	—-
	9-15	18-27	10.0-20.0	6.6-7.8	0-1	—-	—-	—-
	15-60	2-8	1.0-5.0	7.4-8.4	5-20	—-	—-	—-
Coe-------------	0-7	6-18	10.0-15.0	6.6-7.8	0-5	—-	—-	—-
	7-60	2-8	1.0-5.0	7.4-8.4	5-20	—-	—-	—-
2286:								
Aberdeen--------	0-11	27-34	15.0-30.0	5.6-7.3	—-	—-	0-2	—-
	11-25	35-55	15.0-40.0	6.6-8.4	—-	0-1	0-4	1-10
	25-47	20-39	10.0-25.0	7.4-9.0	0-5	0-5	2-8	5-15
	47-60	10-45	5.0-25.0	7.4-9.0	0-10	0-5	2-8	5-15
Bearden---------	0-7	18-26	15.0-30.0	7.4-8.4	0-10	0-1	0-4	0-2
	7-12	18-34	5.0-25.0	7.4-8.4	10-45	0-1	0-4	0-3
	12-22	18-34	5.0-20.0	7.4-8.4	5-20	0-5	0-4	0-10
	22-60	18-59	5.0-35.0	7.4-8.4	5-20	0-5	0-8	0-10

Table 21.—Chemical Properties of the Soils--Continued

Dashes (—) indicate that data were not available or were not estimated.

Map symbol and soil name	Depth	Clay	Cation-exchange capacity	Soil reaction (pH)	Calcium carbonate	Gypsum	Salinity	Sodium adsorption ratio
	Inches	Pct.	meq/100g		Pct.	Pct.	Pct.	
2287:								
Bearden---------	0-7	18-26	15.0-30.0	7.4-8.4	0-10	0-1	0-4	0-2
	7-12	18-34	5.0-25.0	7.4-8.4	10-45	0-1	0-4	0-3
	12-22	18-34	5.0-20.0	7.4-8.4	5-20	0-5	0-4	0-10
	22-60	18-59	5.0-35.0	7.4-8.4	5-20	0-5	0-8	0-10
Lindaas---------	0-12	18-26	15.0-30.0	6.6-7.3	—	—	—	—
	12-29	40-50	20.0-40.0	6.6-7.8	—	—	—	0-1
	29-60	25-40	10.0-30.0	7.4-8.4	0-5	0-1	—	0-2
2288:								
Brantford-------	0-9	10-19	10.0-25.0	6.1-7.8	—	—	—	—
	9-15	18-27	10.0-20.0	6.6-7.8	0-1	—	—	—
	15-60	2-8	1.0-5.0	7.4-8.4	5-20	—	—	—
Divide----------	0-7	15-27	10.0-30.0	7.4-8.4	1-15	—	—	—
	7-25	18-35	10.0-30.0	7.4-8.4	15-35	0-1	0-2	—
	25-60	1-10	2.0-10.0	7.4-8.4	10-30	—	—	—
2289:								
Buse------------	0-8	18-27	10.0-30.0	6.6-8.4	1-10	—	—	—
	8-60	18-35	5.0-25.0	7.4-8.4	10-30	0-1	0-4	0-2
Svea------------	0-15	18-26	—	6.1-7.8	—	—	—	—
	15-21	18-28	—	6.6-7.8	—	—	—	—
	21-60	18-28	—	7.4-8.4	—	—	—	—
Lamoure---------	0-10	27-34	25.0-32.0	7.4-8.4	0-10	—	0-4	1-2
	10-22	20-34	24.0-31.0	7.4-8.4	9-20	—	0-4	1-3
	22-42	20-34	20.0-29.0	7.4-8.4	9-20	0-1	0-4	1-3
	42-60	20-34	16.0-23.0	7.4-8.4	4-20	0-2	0-4	1-3
2290:								
Coe-------------	0-7	6-18	5.0-15.0	6.6-7.8	0-5	—	—	—
	7-60	2-8	1.0-5.0	7.4-8.4	5-20	—	—	—
Binford---------	0-8	6-18	5.0-20.0	5.6-7.8	—	—	—	—
	8-18	6-18	5.0-15.0	5.6-8.4	0-1	—	—	—
	18-60	2-8	1.0-5.0	7.4-8.4	5-20	—	—	—
2291:								
Great Bend------	0-6	18-26	10.0-25.0	6.1-7.8	—	—	0-2	—
	6-13	18-34	10.0-25.0	6.6-8.4	—	—	0-2	—
	13-30	18-34	5.0-20.0	7.4-8.4	0-10	—	0-2	—
	30-60	18-34	5.0-20.0	7.4-8.4	0-10	—	0-4	—
Zell------------	0-6	10-18	10.0-20.0	6.6-8.4	0-5	—	0-2	—
	6-12	10-18	5.0-15.0	7.4-8.4	10-20	—	0-2	—
	12-60	5-18	2.0-10.0	7.4-8.4	5-15	—	0-2	—

Table 21.—Chemical Properties of the Soils--Continued

Dashes (—) indicate that data were not available or were not estimated.

Map symbol and soil name	Depth	Clay	Cation-exchange capacity	Soil reaction (pH)	Calcium carbonate	Gypsum	Salinity	Sodium adsorption ratio
	Inches	Pct.	meq/100g		Pct.	Pct.	Pct.	
2292:								
Hamerly---------	0-10	18-27	15.0-30.0	6.6-8.4	0-10	—-	0-2	—-
	10-30	18-35	10.0-20.0	7.4-8.4	15-35	0-2	0-4	0-2
	30-60	18-35	10.0-20.0	7.4-8.4	10-30	0-2	0-4	0-2
Barnes----------	0-6	15-27	10.0-30.0	5.6-7.8	—-	—-	0-2	—-
	6-18	18-35	10.0-30.0	6.1-7.8	0-3	—-	0-4	—-
	18-25	18-35	5.0-25.0	7.4-8.4	10-30	0-1	0-4	—-
	25-60	18-35	5.0-25.0	7.4-8.4	10-30	0-1	0-4	0-2
2293:								
Lamoure---------	0-10	27-34	25.0-32.0	7.4-8.4	0-10	—-	0-4	1-2
	10-22	20-34	24.0-31.0	7.4-8.4	9-20	—-	0-4	1-3
	22-42	20-34	20.0-29.0	7.4-8.4	9-20	0-1	0-4	1-3
	42-60	20-34	16.0-23.0	7.4-8.4	4-20	0-2	0-4	1-3
Colvin----------	0-11	18-26	15.0-30.0	6.6-8.4	0-10	0-1	—-	0-2
	11-43	18-34	5.0-30.0	7.4-8.4	10-45	0-1	—-	0-3
	43-60	18-34	5.0-25.0	7.4-8.4	5-20	0-5	—-	0-10
2324:								
Wyndmere--------	0-14	5-15	10.0-25.0	7.4-8.4	10-20	0-1	—-	0-1
	14-38	3-15	2.0-15.0	7.4-8.4	15-35	0-1	—-	0-1
	38-44	3-15	1.0-10.0	7.4-8.4	5-20	0-1	—-	0-3
	44-60	18-35	5.0-25.0	7.4-8.4	5-25	0-1	—-	0-3
Tiffany---------	0-10	10-18	10.0-25.0	6.1-7.8	—-	—-	—-	—-
	10-51	5-18	5.0-20.0	6.1-8.4	0-5	—-	—-	—-
	51-60	10-35	5.0-25.0	7.4-8.4	0-5	—-	—-	—-

Table 22.—Water Features

(Dashes (—) indicate that an assignment has not been made.)

Map symbol and soil name	Hydrologic group	Flooding			High water table and ponding				
		Frequency	Duration	Months	Water table depth	Kind of water table	Months	Ponding duration	Maximum ponding depth
				Feet					
118:									
Barnes	B	None	—	—	>6.0	—	—	—	—
Buse	B	None	—	—	>6.0	—	—	—	—
120:									
Barnes	B	None	—	—	>6.0	—	—	—	—
Buse	B	None	—	—	>6.0	—	—	—	—
154:									
Barnes	B	None	—	—	>6.0	—	—	—	—
Svea	B	None	—	—	3.0-5.0	Apparent	Apr-Jun	—	—
167:									
Bearden	C	None	—	—	1.5-3.5	Apparent	Apr-Jun	—	—
314:									
Buse	B	None	—	—	>6.0	—	—	—	—
Barnes	B	None	—	—	>6.0	—	—	—	—
450:									
Colvin	C/D	None	—	—	0.0-1.5	Apparent	Apr-Jul	—	—
511:									
Divide	C	None	—	—	1.5-3.5	Apparent	Apr-Jun	—	—
553:									
Egeland	B	None	—	—	>6.0	—	—	—	—
Embden	B	None	—	—	3.0-5.0	Apparent	Apr-Jun	—	—
846:									
Great Bend	B	None	—	—	>6.0	—	—	—	—
Overly	C	None	—	—	3.0-5.0	Apparent	Apr-Jun	—	—
871:									
Hamerly	C	None	—	—	1.5-3.5	Apparent	Apr-Jun	—	—
Cresbard	C	None	—	—	4.0-6.0	Apparent	Apr-Jun	—	—
883:									
Hamerly	C	None	—	—	1.5-3.5	Apparent	Apr-Jun	—	—
Tonka	C/D	None	—	—	—	—	Apr-Jun	—	1.0
Parnell	C/D	None	—	—	—	Apparent	Nov-Jul	—	2.0
926:									
Hecla	A	None	—	—	3.0-5.0	Apparent	Apr-Jun	—	—
966:									
Hegne	D	None	—	—	0.0-1.5	Apparent	Mar-Jul	—	—

Table 22.—Water Features--Continued

(Dashes (—) indicate that an assignment has not been made.)

		Flooding			High water table and ponding				
Map symbol and soil name	Hydrologic group	Frequency	Duration	Months	Water table depth	Kind of water table	Months	Ponding duration	Maximum ponding depth
				Feet					
971:									
Hegne----------	D	None	—	—	0.0-1.5	Apparent	Mar-Jul	—	—
Fargo----------	D	None	—	—	0.5-1.5	Apparent	Mar-Jul	—	—
1221:									
Maddock--------	A	None	—	—	>6.0	—	—	—	—
Hecla----------	A	None	—	—	3.0-5.0	Apparent	Apr-Jun	—	—
1267:									
Marysland------	B/D	None	—	—	0.0-1.5	Apparent	Mar-Jul	—	—
1426:									
Parnell--------	C/D	None	—	—	—	Apparent	Nov-Jul	—	2.0
1466:									
Pits, gravel and sand------	A	None	—	—	>6.0	—	—	—	—
1710:									
Southam--------	D	None	—	—	—	Apparent	Jan-Dec	—	5.0
1782:									
Swenoda--------	B	None	—	—	3.0-5.0	Perched	Apr-Jun	—	—
1884:									
Vallers--------	D	None	—	—	0.0-1.5	Apparent	Mar-Jun	—	—
Parnell--------	C/D	None	—	—	—	Apparent	Nov-Jul	—	1.0
1886:									
Hamerly--------	C	None	—	—	1.5-3.5	Apparent	Apr-Jun	—	—
Vallers--------	D	None	—	—	0.0-1.5	Apparent	Mar-Jun	—	—
1978:									
Water	—	—	—	—	—	—	—	—	—
2048:									
Wyndmere-------	C	None	—	—	1.5-3.5	Apparent	Apr-Jun	—	—
2151:									
Binford--------	B	None	—	—	>6.0	—	—	—	—
Coe------------	A	None	—	—	>6.0	—	—	—	—
2196:									
Bearden--------	C	None	—	—	1.5-3.5	Apparent	Apr-Jun	—	—
Colvin---------	C/D	None	—	—	0.0-1.5	Apparent	Mar-Jun	—	—
2208:									
Brantford------	B	None	—	—	>6.0	—	—	—	—
Coe------------	A	None	—	—	>6.0	—	—	—	—

Table 22.—Water Features--Continued

(Dashes (—) indicate that an assignment has not been made.)

		Flooding			High water table and ponding				
Map symbol and soil name	Hydrologic group	Frequency	Duration	Months	Water table depth	Kind of water table	Months	Ponding duration	Maximum ponding depth
				Feet					
2286:									
Aberdeen--------	C	None	—	—	3.0-5.0	Apparent	Apr-Jun	—	—
Bearden---------	C	None	—	—	1.5-3.5	Apparent	Apr-Jun	—	—
2287:									
Bearden---------	C	None	—	—	1.5-3.5	Apparent	Apr-Jun	—	—
Lindaas---------	C/D	None	—	—	—	Perched	Mar-Jun	—	1.0
2288:									
Brantford-------	B	None	—	—	>6.0	—	—	—	—
Divide----------	C	None	—	—	1.5-3.5	Apparent	Apr-Jun	—	—
2289:									
Buse------------	B	None	—	—	>6.0	—	—	—	—
Svea------------	B	None	—	—	>6.0	—	—	—	—
Lamoure---------	C	Frequent	Brief	Mar-Oct	0.0-1.5	Apparent	Oct-Jun	—	—
2290:									
Coe-------------	A	None	—	—	>6.0	—	—	—	—
Binford---------	B	None	—	—	—	—	—	—	—
2291									
Great Bend------	B	None	—	—	>6.0	—	—	—	—
Zell------------	B	None	—	—	>6.0	—	—	—	—
2292:									
Hamerly---------	C	None	—	—	1.5-3.5	Apparent	Apr-Jun	—	—
Barnes----------	B	None	—	—	>6.0	—	—	—	—
2293:									
Lamoure---------	C	Frequent	Brief	Mar-Oct	0.0-1.5	Apparent	Oct-Jun	—	—
Colvin----------	C/D	Frequent	Brief	Mar-Oct	0.0-1.5	Apparent	Mar-Jul	—	—
2324:									
Wyndmere--------	C	None	—	—	1.5-3.5	Apparent	Apr-Jun	—	—
Tiffany---------	C	None	—	—	1.5-3.5	Apparent	Apr-Jun	—	—

Table 23.—Soil Features

(Dashes (—) indicate that an assignment has not been made.)

Map symbol and soil name	Bedrock		Cemented pan		Subsidence		Potential frost action	Risk of corrosion	
	Depth	Hardness	Depth	Kind	Initial	Total		Uncoated steel	Concrete
	Inches		Inches		Inches	Inches			
118:									
Barnes	>60	—	—	—	—	—	Moderate	Moderate	Low
Buse	>60	—	—	—	—	—	Moderate	Moderate	Low
120:									
Barnes	>60	—	—	—	—	—	Moderate	Moderate	Low
Buse	>60	—	—	—	—	—	Moderate	Moderate	Low
154:									
Barnes	>60	—	—	—	—	—	Moderate	Moderate	Low
Svea	>60	—	—	—	—	—	Moderate	High	Low
167:									
Bearden	>60	—	—	—	—	—	High	High	Low
314:									
Buse	>60	—	—	—	—	—	Moderate	Moderate	Low
Barnes	>60	—	—	—	—	—	Moderate	Moderate	Low
450:									
Colvin	>60	—	—	—	—	—	High	High	Low
511:									
Divide	>60	—	—	—	—	—	Moderate	High	Low
553:									
Egeland	>60	—	—	—	—	—	Moderate	Low	Low
Embden	>60	—	—	—	—	—	Moderate	Moderate	Low
846:									
Great Bend	>60	—	—	—	—	—	High	High	Low
Overly	>60	—	—	—	—	—	High	High	Low
871:									
Hamerly	>60	—	—	—	—	—	High	High	Low
Cresbard	>60	—	—	—	—	—	Moderate	High	Moderate
883:									
Hamerly	>60	—	—	—	—	—	High	High	Low
Tonka	>60	—	—	—	—	—	High	High	Low
Parnell	>60	—	—	—	—	—	High	High	Low
926:									
Hecla	>60	—	—	—	—	—	Moderate	Low	Low
966:									
Hegne	>60	—	—	—	—	—	High	High	Low
971:									
Hegne	>60	—	—	—	—	—	High	High	Low
Fargo	>60	—	—	—	—	—	High	High	Low

Table 23.—Soil Features--Continued

(Dashes (—) indicate that an assignment has not been made.)

Map symbol and soil name	Bedrock		Cemented pan		Subsidence		Potential frost action	Risk of corrosion	
	Depth	Hardness	Depth	Kind	Initial	Total		Uncoated steel	Concrete
	Inches		Inches		Inches	Inches			
1221:									
Maddock	>60	—	—	—	—	—	Low	Low	Low
Hecla	>60	—	—	—	—	—	Moderate	Low	Low
1267:									
Marysland	>60	—	—	—	—	—	High	High	Low
1426:									
Parnell	>60	—	—	—	—	—	High	High	Low
1466:									
Pits, gravel and sand	>60	—	—	—	—	—	None	Low	Low
1710:									
Southam	>60	—	—	—	—	—	High	High	Low
1782:									
Swenoda	>60	—	—	—	—	—	Moderate	High	Low
1884:									
Vallers	>60	—	—	—	—	—	High	High	Moderate
Parnell	>60	—	—	—	—	—	High	High	Low
1886:									
Hamerly	>60	—	—	—	—	—	High	High	Moderate
Vallers	>60	—	—	—	—	—	High	High	Moderate
1978:									
Water	—	—	—	—	—	—	—	—	—
2048:									
Wyndmere	>60	—	—	—	—	—	High	Moderate	Low
2151:									
Binford	>60	—	—	—	—	—	Low	Low	Low
Coe	>60	—	—	—	—	—	Low	Low	Low
2196:									
Bearden	>60	—	—	—	—	—	High	High	Moderate
Colvin	>60	—	—	—	—	—	High	High	Moderate
2208:									
Brantford	>60	—	—	—	—	—	Low	Low	Low
Coe	>60	—	—	—	—	—	Low	Low	Low
2286:									
Aberdeen	>60	—	—	—	—	—	Moderate	High	Moderate
Bearden	>60	—	—	—	—	—	High	High	Low

Table 23.—Soil Features--Continued

(Dashes (—) indicate that an assignment has not been made.)

Map symbol and soil name	Bedrock		Cemented pan		Subsidence		Potential frost action	Risk of corrosion	
	Depth	Hardness	Depth	Kind	Initial	Total		Uncoated steel	Concrete
	Inches		Inches		Inches	Inches			
2287:									
Bearden	>60	—	—	—	—	—	High	High	Low
Lindaas	>60	—	—	—	—	—	High	High	Low
2288:									
Brantford	>60	—	—	—	—	—	Low	Low	Low
Divide	>60	—	—	—	—	—	Moderate	High	Low
2289:									
Buse	>60	—	—	—	—	—	Moderate	Moderate	Low
Svea	>60	—	—	—	—	—	Moderate	High	Low
Lamoure	>60	—	—	—	—	—	High	High	Moderate
2290:									
Coe	>60	—	—	—	—	—	Low	Low	Low
Binford	>60	—	—	—	—	—	Low	Low	Low
2291:									
Great Bend	>60	—	—	—	—	—	High	High	Low
Zell	>60	—	—	—	—	—	High	Low	Low
2292:									
Hamerly	>60	—	—	—	—	—	High	High	Low
Barnes	>60	—	—	—	—	—	Moderate	Moderate	Low
2293:									
Lamoure	>60	—	—	—	—	—	High	High	Moderate
Colvin	>60	—	—	—	—	—	High	High	Low
2324:									
Wyndmere	>60	—	—	—	—	—	High	High	Low

Table 24.—Hydric Soils List

See end of table for criteria codes and definitions.

There may be small areas of included soils or miscellaneous areas that are significant to use and management of the soil; yet are to small to delineate on the soil map at the map's original scale. These may be designed as spot symbols and are described on the Conventional and Special Symbols Legend

Map symbol and map unit name	Component	Hydric	Local landform	Hydric soils criteria			
				Hydric criteria code	Meets saturation criteria	Meets flooding criteria	Meets ponding criteria
118:							
BARNES-BUSE LOAMS, 3 TO 6 PERCENT SLOPES	BARNES	No	—	—	—	—	—
	BUSE	No	—	—	—	—	—
	SVEA	No	—	—	—	—	—
	HAMERLY	No	—	—	—	—	—
	TONKA	Yes	Depression	2B3,3	Yes	No	Yes
	COE	No	—	—	—	—	—
	HECLA	No	—	—	—	—	—
	PARNELL	Yes	Depression	2B3,3	Yes	No	Yes
120:							
BARNES-BUSE LOAMS, 6 TO 9 PERCENT SLOPES	BARNES	No	—	—	—	—	—
	BUSE	No	—	—	—	—	—
	SVEA	No	—	—	—	—	—
	HAMERLY	No	—	—	—	—	—
	COE	No	—	—	—	—	—
	BINFORD	No	—	—	—	—	—
	SWENoDA	No	—	—	—	—	—
	TONKA	Yes	Depression	2B3,3	Yes	No	Yes
54:							
BARNES-SVEA LOAMS, 0 TO 3 PERCENT SLOPES	BARNES	No	—	—	—	—	—
	SVEA	No	—	—	—	—	—
	HAMERLY	No	—	—	—	—	—
	BUSE	No	—	—	—	—	—
	CRESBARD	No	—	—	—	—	—
	PARNELL	Yes	Depression	3,2B3	Yes	No	Yes
	TONKA	Yes	Depression	3,2B3	Yes	No	Yes
	VALLERS	Yes	Flat	2B3	Yes	No	No

Table 24.—Hydric Soils List--Continued

See end of table for criteria codes and definitions.

There may be small areas of included soils or miscellaneous areas that are significant to use and management of the soil; yet are to small to delineate on the soil map at the map's original scale. These may be designed as spot symbols and are described on the Conventional and Special Symbols Legend

Map symbol and map unit name	Component	Hydric	Local landform	Hydric soils criteria			
				Hydric criteria code	Meets saturation criteria	Meets flooding criteria	Meets ponding criteria
167:							
BEARDEN SILT LOAM	BEARDEN	No	—	—	—	—	—
	BEARDEN, SALINE	No	—	—	—	—	—
	OVERLY	No	—	—	—	—	—
	GLYNDON	No	—	—	—	—	—
	COLVIN	Yes	Depression	2B3	Yes	No	No
	WYNDMERE	No	—	—	—	—	—
	LINDAAS	Yes	Depression	2B3,3	Yes	No	Yes
314:							
BUSE-BARNES LOAMS, 9 TO 15 PERCENT SLOPES	BUSE	No	—	—	—	—	—
	BARNES	No	—	—	—	—	—
	SVEA	No	—	—	—	—	—
	LANGHEI	No	—	—	—	—	—
	COE	No	—	—	—	—	—
	HAMERLY	No	—	—	—	—	—
	PARNELL	Yes	Depression	3,2B3	Yes	No	Yes
450:							
COLVIN SILT LOAM	COLVIN	Yes	Depression	2B3	Yes	No	No
	LAMOURE	Yes	Channel	4,2B3	Yes	Yes	No
	COLVIN, SALINE	Yes	Flat	2B3	Yes	No	No
	BEARDEN	No	—	—	—	—	—
	VALLERS	Yes	Flat	2B3	Yes	No	No
	TONKA	Yes	Depression	2B3,3	Yes	No	Yes
	LINDAAS	Yes	Depression	2B3,3	Yes	No	Yes

Table 24.—Hydric Soils List--Continued

See end of table for criteria codes and definitions.

There may be small areas of included soils or miscellaneous areas that are significant to use and management of the soil; yet are to small to delineate on the soil map at the map's original scale. These may be designed as spot symbols and are described on the Conventional and Special Symbols Legend

Map symbol and map unit name	Component	Hydric	Local landform	Hydric soils criteria			
				Hydric criteria code	Meets saturation criteria	Meets flooding criteria	Meets ponding criteria
511:							
DIVIDE LOAM, 0 TO 3 PERCENT SLOPES	DIVIDE	No	—	—	—	—	—
	BRANTFORD	No	—	—	—	—	—
	BARNES	No	—	—	—	—	—
	WYNDMERE	No	—	—	—	—	—
	VALLERS	Yes	Flat	2B3	Yes	No	No
	PARNELL	Yes	Depression	2B3,3	Yes	No	Yes
	TONKA	Yes	Depression	2B3,3	Yes	No	Yes
553:							
EGELAND-EMBDEN FINE SANDY LOAMS, 0 TO 3 PERCENT SLOPES	EGELAND	No	—	—	—	—	—
	EMBDEN	No	—	—	—	—	—
	WYNDMERE	No	—	—	—	—	—
	ZELL	No	—	—	—	—	—
	MADDOCK	No	—	—	—	—	—
	BEARDEN	No	—	—	—	—	—
	HAMERLY	No	—	—	—	—	—
846:							
GREAT BEND-OVERLY SILT LOAMS, 0 TO 3 PERCENT SLOPES	GREAT BEND	No	—	—	—	—	—
	OVERLY	No	—	—	—	—	—
	BEARDEN	No	—	—	—	—	—
	ECKMAN	No	—	—	—	—	—
	GLYNDON	No	—	—	—	—	—
	ZELL	No	—	—	—	—	—
	COLVIN, SALINE	Yes	Flat	2B3	Yes	No	No
	LINDAAS	Yes	Depression	2B3,3	Yes	No	Yes

Table 24.—Hydric Soils List--Continued

See end of table for criteria codes and definitions.

There may be small areas of included soils or miscellaneous areas that are significant to use and management of the soil; yet are to small to delineate on the soil map at the map's original scale. These may be designed as spot symbols and are described on the Conventional and Special Symbols Legend

Map symbol and map unit name	Component	Hydric	Local landform	Hydric soils criteria			
				Hydric criteria code	Meets saturation criteria	Meets flooding criteria	Meets ponding criteria
871:							
HAMERLY-CRESBARD LOAMS, 0 TO 3 PERCENT SLOPES	HAMERLY	No	—	—	—	—	—
	CRESBARD	No	—	—	—	—	—
	HAMERLY, SALINE	No	—	—	—	—	—
	BARNES	No	—	—	—	—	—
	BEARDEN	No	—	—	—	—	—
	BUSE	No	—	—	—	—	—
	TONKA	Yes	Depression	2B3,3	Yes	No	Yes
	VALLERS	Yes	Flat	2B3	Yes	No	No
883:							
HAMERLY-TONKA-PARNELL COMPLEX, 0 TO 3 PERCENT SLOPES	HAMERLY	No	—	—	—	—	—
	TONKA	Yes	Depression	2B3,3	Yes	No	Yes
	PARNELL	Yes	Depression	2B3,3	Yes	No	Yes
	VALLERS	Yes	Flat	2B3	Yes	No	No
	BARNES	No	—	—	—	—	—
	HAMERLY, SALINE	No	—	—	—	—	—
	WYARD	No	—	—	—	—	—
	PERELLA	Yes	Depression	2B3,3	Yes	No	Yes
	SOUTHAM	Yes	Depression	2B3,3	Yes	No	Yes
926:							
HECLA LOAMY FINE SAND, 0 TO 3 PERCENT SLOPES	HECLA	No	—	—	—	—	—
	TOWNER	No	—	—	—	—	—
	HAMAR	Yes	Flat	2B2	Yes	No	No
	SWENODA	No	—	—	—	—	—
	ULEN	No	—	—	—	—	—
	BEARDEN	No	—	—	—	—	—
	SVEA	No	—	—	—	—	—

Table 24.—Hydric Soils List--Continued

See end of table for criteria codes and definitions.

There may be small areas of included soils or miscellaneous areas that are significant to use and management of the soil; yet are to small to delineate on the soil map at the map's original scale. These may be designed as spot symbols and are described on the Conventional and Special Symbols Legend

Map symbol and map unit name	Component	Hydric	Local landform	Hydric soils criteria			
				Hydric criteria code	Meets saturation criteria	Meets flooding criteria	Meets ponding criteria
966:							
HEGNE SILTY CLAY, SALINE	HEGNE	Yes	Lake Plain	2B3,3	Yes	No	Yes
	HEGNE, NoNSALINE	Yes	Lake Plain	2B3	Yes	No	No
	FARGO	Yes	Lake Plain	2B3	Yes	No	No
	COLVIN	Yes	Flat	2B3	Yes	No	No
	LALLIE	Yes	Flat	2B3	Yes	No	No
	MARYSLAND	Yes	Flat	2B3	Yes	No	No
	GRANo	Yes	Depression	2B3,3	Yes	No	Yes
971:							
HEGNE-FARGO SILTY CLAYS	HEGNE	Yes	Lake Plain	2B3	Yes	No	No
	FARGO	Yes	Lake Plain	2B3	Yes	No	No
	HEGNE, SALINE	Yes	Lake Plain	2B3,3	Yes	No	Yes
	BEARDEN	No	—	—	—	—	—
	DOVRAY	Yes	Depression	3,2B3	Yes	No	Yes
	GRANo	Yes	Depression	2B3,3	Yes	No	Yes
	PERELLA	Yes	Depression	2B3,3	Yes	No	Yes
	COLVIN	Yes	Flat	2B3	Yes	No	No
1221:							
MADDOCK-HECLA LOAMY FINE SANDS, 1 TO 6 PERCENT SLOPES	MADDOCK	No	—	—	—	—	—
	HECLA	No	—	—	—	—	—
	TOWNER	No	—	—	—	—	—
	EMBDEN	No	—	—	—	—	—
	BRANTFORD	No	—	—	—	—	—
	BUSE	No	—	—	—	—	—
	SVEA	No	—	—	—	—	—
	ULEN	No	—	—	—	—	—

Table 24.—Hydric Soils List--Continued

See end of table for criteria codes and definitions.

There may be small areas of included soils or miscellaneous areas that are significant to use and management of the soil; yet are to small to delineate on the soil map at the map's original scale. These may be designed as spot symbols and are described on the Conventional and Special Symbols Legend

Map symbol and map unit name	Component	Hydric	Local landform	Hydric soils criteria			
				Hydric criteria code	Meets saturation criteria	Meets flooding criteria	Meets ponding criteria
1267:							
MARYSLAND LOAM	MARYSLAND	Yes	Flat	2B3	Yes	No	No
	DIVIDE	No	—	—	—	—	—
	COLVIN	Yes	Flat	2B3	Yes	No	No
	MARYSLAND, SALINE	Yes	Flat	2B3	Yes	No	No
	SOUTHAM	Yes	Depression	3,2B3	Yes	No	Yes
	ARVESON	Yes	Flat	2B3	Yes	No	No
	BEARDEN	No	—	—	—	—	—
1426:							
PARNELL SILT LOAM	PARNELL	Yes	Depression	2B3,3	Yes	No	Yes
	TONKA	Yes	Depression	2B3,3	Yes	No	Yes
	VALLERS	Yes	Flat	2B3	Yes	No	No
	WYARD	No	—	—	—	—	—
	HAMERLY	No	—	—	—	—	—
	SOUTHAM	Yes	Depression	2B3,3	Yes	No	Yes
1466:							
PITS, GRAVEL AND SAND	PITS, GRAVEL AND SAND	No	—	—	—	—	—
	BINFORD	No	—	—	—	—	—
	BRANTFORD	No	—	—	—	—	—
	COE	No	—	—	—	—	—
	ARVILLA	No	—	—	—	—	—
	RENSHAW	No	—	—	—	—	—
	SIOUX	No	—	—	—	—	—
1710:							
SOUTHAM SILTY CLAY LOAM	SOUTHAM	Yes	Depression	2B3,3	Yes	No	Yes
	PARNELL	Yes	Depression	2B3,3	Yes	No	Yes
	COLVIN	Yes	Depression	2B3	Yes	No	No
	COLVIN, SALINE	Yes	Flat	2B3	Yes	No	No

Table 24.—Hydric Soils List--Continued

See end of table for criteria codes and definitions.

There may be small areas of included soils or miscellaneous areas that are significant to use and management of the soil; yet are to small to delineate on the soil map at the map's original scale. These may be designed as spot symbols and are described on the Conventional and Special Symbols Legend

Map symbol and map unit name	Component	Hydric	Local landform	Hydric soils criteria			
				Hydric criteria code	Meets saturation criteria	Meets flooding criteria	Meets ponding criteria
1710: (con't)							
	VALLERS	Yes	Flat	2B3	Yes	No	No
	VALLERS, SALINE	Yes	Flat	2B3	Yes	No	No
1782:							
SWENODA FINE SANDY LOAM, 0 TO 6 PERCENT SLOPES	SWENODA	No	—	—	—	—	—
	TOWNER	No	—	—	—	—	—
	LANONA	No	—	—	—	—	—
	HAMERLY	No	—	—	—	—	—
	WYNDMERE	No	—	—	—	—	—
	BUSE	No	—	—	—	—	—
	ARVESON	Yes	Depression	2B3	Yes	No	No
1884:							
VALLERS, SALINE-PARNELL COMPLEX	VALLERS	Yes	Flat	2B3	Yes	No	No
	PARNELL	Yes	Depression	2B3,3	Yes	No	Yes
	VALLERS, NoNSALINE	Yes	Flat	2B3	Yes	No	No
	HAMERLY	No	—	—	—	—	—
	TONKA	Yes	Depression	2B3,3	Yes	No	Yes
	MARYSLAND	Yes	Flat	2B3	Yes	No	No
	SOUTHAM	Yes	Depression	2B3,3	Yes	No	Yes
	BARNES	No	—	—	—	—	—
1886:							
HAMERLY AND VALLERS LOAMS, SALINE, 0 TO 3 PERCENT SLOPES	HAMERLY	No	—	—	—	—	—
	VALLERS	Yes	Flat	2B3	Yes	No	No
	HAMERLY, NoNSALINE	No	—	—	—	—	—
	VALLERS, NoNSALINE	Yes	Flat	2B3	Yes	No	No
	BARNES	No	—	—	—	—	—

Table 24.—Hydric Soils List--Continued

See end of table for criteria codes and definitions.

There may be small areas of included soils or miscellaneous areas that are significant to use and management of the soil; yet are to small to delineate on the soil map at the map's original scale. These may be designed as spot symbols and are described on the Conventional and Special Symbols Legend

Map symbol and map unit name	Component	Hydric	Local landform	Hydric soils criteria			
				Hydric criteria code	Meets saturation criteria	Meets flooding criteria	Meets ponding criteria
1886: (con't)							
	PARNELL	Yes	Depression	3,2B3	Yes	No	Yes
	TONKA	Yes	Depression	3,2B3	Yes	No	Yes
	WYNDMERE	No	—	—	—	—	—
1978:							
WATER	WATER	Yes	Depression	2B3,3	Yes	No	Yes
2048:							
WYNDMERE FINE SANDY LOAM, 0 TO 3 PERCENT SLOPES	WYNDMERE	No	—	—	—	—	—
	ULEN	No	—	—	—	—	—
	HAMAR	Yes	Flat	2B3	Yes	No	No
	HAMERLY	No	—	—	—	—	—
	EMBDEN	No	—	—	—	—	—
	HECLA	No	—	—	—	—	—
	COLVIN, SALINE	Yes	Flat	2B3	Yes	No	No
2151:							
BINFORD-COE SANDY LOAMS, 0 TO 6 PERCENT SLOPES	BINFORD	No	—	—	—	—	—
	COE	No	—	—	—	—	—
	BRANTFORD	No	—	—	—	—	—
	WYRENE	No	—	—	—	—	—
	EMBDEN	No	—	—	—	—	—
	MARYSLAND	Yes	Flat	2B3	Yes	No	No
	WYNDMERE	No	—	—	—	—	—
2196:							
BEARDEN AND COLVIN SILT LOAMS, SALINE	BEARDEN	No	—	—	—	—	—
	COLVIN	Yes	Flat	2B3	Yes	No	No
	COLVIN, NoNSALINE	Yes	Flat	2B3	Yes	No	No
	BEARDEN, NoNSALINE	No	—	—	—	—	—
	ABERDEEN	No	—	—	—	—	—

Table 24.—Hydric Soils List--Continued

See end of table for criteria codes and definitions.

There may be small areas of included soils or miscellaneous areas that are significant to use and management of the soil; yet are to small to delineate on the soil map at the map's original scale. These may be designed as spot symbols and are described on the Conventional and Special Symbols Legend

Map symbol and map unit name	Component	Hydric	Local landform	Hydric soils criteria			
				Hydric criteria code	Meets saturation criteria	Meets flooding criteria	Meets ponding criteria
2196: (con't)	EXLINE	No	—	—	—	—	—
	OVERLY	No	—	—	—	—	—
	PARNELL	Yes	Depression	2B3,3	Yes	No	Yes
2208:							
BRANTFORD-COE LOAMS, 1 TO 6 PERCENT SLOPES	BRANTFORD	No	—	—	—	—	—
	COE	No	—	—	—	—	—
	BINFORD	No	—	—	—	—	—
	DIVIDE	No	—	—	—	—	—
	VANG	No	—	—	—	—	—
	BARNES	No	—	—	—	—	—
	MARYSLAND	Yes	Flat	2B3	Yes	No	No
	VALLERS	Yes	Flat	2B3	Yes	No	No
2286:							
ABERDEEN-BEARDEN COMPLEX	ABERDEEN	No	—	—	—	—	—
	BEARDEN	No	—	—	—	—	—
	OVERLY	No	—	—	—	—	—
	GREAT BEND	No	—	—	—	—	—
	LINDAAS	Yes	Depression	2B3,3	Yes	No	Yes
	BEARDEN, SALINE	No	—	—	—	—	—
	EXLINE	No	—	—	—	—	—
	FARGO	Yes	Lake Plain	2B3	Yes	No	No
2287:							
BEARDEN-LINDAAS SILT LOAMS	BEARDEN	No	—	—	—	—	—
	LINDAAS	Yes	Depression	2B3,3	Yes	No	Yes
	PERELLA	No	—	—	—	—	—
	BEARDEN, SALINE	No	—	—	—	—	—
	OVERLY	No	—	—	—	—	—

Table 24.—Hydric Soils List--Continued

See end of table for criteria codes and definitions.

There may be small areas of included soils or miscellaneous areas that are significant to use and management of the soil; yet are to small to delineate on the soil map at the map's original scale. These may be designed as spot symbols and are described on the Conventional and Special Symbols Legend

Map symbol and map unit name	Component	Hydric	Local landform	Hydric soils criteria			
				Hydric criteria code	Meets saturation criteria	Meets flooding criteria	Meets ponding criteria
2286: (con't)							
	HEGNE	Yes	Lake Plain	2B3	Yes	No	No
	GREAT BEND	No	—	—	—	—	—
	ABERDEEN	No	—	—	—	—	—
2288:							
BRANTFORD-DIVIDE LOAMS, 1 TO 3 PERCENT SLOPES	BRANTFORD	No	—	—	—	—	—
	DIVIDE	No	—	—	—	—	—
	VANG	No	—	—	—	—	—
	HAMERLY	No	—	—	—	—	—
	COE	No	—	—	—	—	—
	WYRENE	No	—	—	—	—	—
	BARNES	No	—	—	—	—	—
	PARNELL	Yes	Depression	2B3,3	Yes	No	Yes
2289:							
BUSE-SVEA-LAMOURE COMPLEX, 0 TO 35 PERCENT SLOPES	BUSE	No	—	—	—	—	—
	LAMOURE	Yes	drainageway	2B3	Yes	No	No
	SVEA	No	—	—	—	—	—
	LAPRAIRIE	No	—	—	—	—	—
	BARNES	No	—	—	—	—	—
	LANGHEI	No	—	—	—	—	—
	ARVESON	Yes	Flat	2B3	Yes	No	No
	SOUTHAM	Yes	Depression	2B3,3	Yes	No	Yes
	MARYSLAND	Yes	Flat	2B3	Yes	No	No
2290:							
COE-BINFORD SANDY LOAMS, 6 TO 15 PERCENT SLOPES	COE	No	—	—	—	—	—
	BINFORD	No	—	—	—	—	—
	MADDOCK	No	—	—	—	—	—
	BARNES	No	—	—	—	—	—

Table 24.—Hydric Soils List--Continued

See end of table for criteria codes and definitions.

There may be small areas of included soils or miscellaneous areas that are significant to use and management of the soil; yet are to small to delineate on the soil map at the map's original scale. These may be designed as spot symbols and are described on the Conventional and Special Symbols Legend

Map symbol and map unit name	Component	Hydric	Local landform	Hydric soils criteria			
				Hydric criteria code	Meets saturation criteria	Meets flooding criteria	Meets ponding criteria
2290: (con't)							
	LAPRAIRIE	No	—	—	—	—	—
	BUSE	No	—	—	—	—	—
	HAMERLY	No	—	—	—	—	—
	WYNDMERE	No	—	—	—	—	—
2291:							
GREAT BEND-ZELL SILT LOAMS, 3 TO 6 PERCENT SLOPES	GREAT BEND	No	—	—	—	—	—
	ZELL	No	—	—	—	—	—
	OVERLY	No	—	—	—	—	—
	EGELAND	No	—	—	—	—	—
	EMBDEN	No	—	—	—	—	—
	BEARDEN	No	—	—	—	—	—
	COE	No	—	—	—	—	—
	TONKA	Yes	Depression	3,2B3	Yes	No	Yes
2292:							
HAMERLY-BARNES LOAMS, 0 TO 3 PERCENT SLOPES	HAMERLY	No	—	—	—	—	—
	BARNES	No	—	—	—	—	—
	VALLERS	Yes	Flat	2B3	Yes	No	No
	SVEA	No	—	—	—	—	—
	TONKA	Yes	Depression	2B3,3	Yes	No	Yes
	BUSE	No	—	—	—	—	—
	CRESBARD	No	—	—	—	—	—
	PARNELL	Yes	Depression	2B3,3	Yes	No	Yes
2293:							
LAMOURE-COLVIN COMPLEX, CHANNELED	LAMOURE	Yes	drainageway	2B3	Yes	No	No
	COLVIN	Yes	drainageway	2B3	Yes	No	No
	LAPRAIRIE	No	—	—	—	—	—
	HAMERLY	No	—	—	—	—	—
	WYARD	No	—	—	—	—	—

Table 24.—Hydric Soils List--Continued

See end of table for criteria codes and definitions.

There may be small areas of included soils or miscellaneous areas that are significant to use and management of the soil; yet are to small to delineate on the soil map at the map's original scale. These may be designed as spot symbols and are described on the Conventional and Special Symbols Legend

Map symbol and map unit name	Component	Hydric	Local landform	Hydric soils criteria			
				Hydric criteria code	Meets saturation criteria	Meets flooding criteria	Meets ponding criteria
2290: (con't)							
	BRANTFORD	No	—	—	—	—	—
	PARNELL	Yes	Depression	2B3,3	Yes	No	Yes
	TONKA	Yes	Depression	2B3,3	Yes	No	Yes
2324:							
WYNDMERE-TIFFANY LOAMS, SILTY SUBSTRATUM	WYNDMERE	No	—	—	—	—	—
	TIFFANY	No	—	—	—	—	—
	BEARDEN	No	—	—	—	—	—
	GARDENA	No	—	—	—	—	—
	SWENoDA	No	—	—	—	—	—
	LINDAAS	Yes	Depression	3,2B3	Yes	No	Yes
	PERELLA	Yes	Depression	3,2B3	Yes	No	Yes

HYDRIC SOILS CRITERIA CODES AND DEFINITIONS

1. All Histosols, except Folists, or

2. Soils in Aquic suborders, great groups, or subgroups, Albolls suborder, Aquisalids, Pachic subgroups, or Cumulic subgroups that are:
   a. somewhat poorly drained with a water table equal to 0.0 foot from the surface during the growing season, or
   b. poorly drained or very poorly drained and have either:
      (1) water table equal to 0.0 feet from the surface during the growing season if textures are coarse sand, sand, or fine sand in all layers within 20 inches or for other soils
      (2) water table at less than or equal to 0.5 feet from the surface during the growing season if permeability is equal to or greater than 6.0 inches/hour in all layers within 20 inches, or
      (3) water table at less than or equal to 1.0 foot from the surface during the growing season if permeability is less than 6.0 inches/hour in any layer within 20 inches, or

3. Soils that are frequently ponded for long duration or very long duration during the growing season, or

4. Soils that are frequently flooded for long duration or very long duration during the growing season.

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Glossary

ABC soil. A soil having an A, a B, and a C horizon.

Ablation till. Loose, permeable till deposited during the final downwasting of glacial ice. Lenses of crudely sorted sand and gravel are common.

AC soil. A soil having only an A and a C horizon. Commonly, such soil formed in recent alluvium or on steep, rocky slopes.

Aeration, soil. The exchange of air in soil with air from the atmosphere. The air in a well aerated soil is similar to that in the atmosphere; the air in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alkali (sodic) soil. A soil having so high a degree of alkalinity (pH 8.5 or higher) or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that plant growth is restricted.

Alluvial fan. The fanlike deposit of a stream where it issues from a gorge upon a plain or of a tributary stream near or at its junction with its main stream.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Alpha, alpha-dipyridyl. A dye that when dissolved in 1N ammonium acetate is used to detect the presence of reduced iron (Fe II) in the soil. A positive reaction indicates a type of redoximorphic feature.

Animal unit month (AUM). The amount of forage required by one mature cow weighing approximately 1,000 pounds, with or without a calf, for 1 month.

Aquic conditions. Current soil wetness characterized by saturation, reduction, and redoximorphic features.

Area reclaim (in tables). An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Argillic horizon. A subsoil horizon characterized by an accumulation of illuvial clay.

Aspect. The direction in which a slope faces.

Association, soil. A group of soils or miscellaneous areas geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

Atterberg Limits. A general term that encompasses liquid limit, plastic limit, and shrinkage limit. It is used as an integral part of several engineering classification systems.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as:

Very low —0 to 3
Low —3 to 6
Moderate —6 to 9
High —9 to 12
Very high —More than 12

Badland. Moderately steep to very steep, commonly nonstony, barren land dissected by many intermittent drainage channels. Badland is most common in semiarid and arid regions where streams are entrenched in soft geologic material. Local relief generally ranges from 25 to 500 feet. Runoff potential is very high, and geologic erosion is active.

Basal till. Compact glacial till deposited beneath the ice.

Base saturation. The degree to which material having cation-exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, and K), expressed as a percentage of the total cation-exchange capacity.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Blowout. A shallow depression from which all or most of the soil material has been removed by the wind. A blowout has a flat or irregular floor formed by a resistant layer or by an accumulation of pebbles or

cobbles. In some blowouts the water table is exposed.

Bottom land. The normal flood plain of a stream, subject to flooding.

Boulders. Rock fragments larger than 2 feet (60 centimeters) in diameter.

Breaks. The steep and very steep broken land at the border of an upland summit that is dissected by ravines.

Brush management. Use of mechanical, chemical, or biological methods to make conditions favorable for reseeding or to reduce or eliminate competition from woody vegetation and thus allow understory grasses and forbs to recover. Brush management increases forage production and thus reduces the hazard of erosion. It can improve the habitat for some species of wildlife.

Butte. An isolated small mountain or hill with steep or precipitous sides and a top variously flat, rounded, or pointed that may be a residual mass isolated by erosion.

$CaCO_3$ Equivalent. The quantity of carbonate (CO_3) in the soil expressed as $CaCO_3$. This material is important to the fertility, erosion, available water holding capacity, and genesis of a soil.

Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

Capillary water. Water held as a film around soil particles and in tiny spaces between particles. Surface tension is the adhesive force that holds capillary water in the soil.

Catena. A sequence, or "chain," of soils on a landscape that formed in similar kinds of parent material but have different characteristics as a result of differences in relief and drainage.

Cation. An ion carrying a positive charge of electricity. The common soil cations are calcium, potassium, magnesium, sodium, and hydrogen.

Cation-exchange capacity. The total amount of exchangeable cations that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. The term, as applied to soils, is synonymous with base-exchange capacity but is more precise in meaning.

Channery soil material. Soil material that is, by volume, 15 to 35 percent thin, flat fragments of sandstone, shale, slate, limestone, or schist as much as 6 inches (15 centimeters) along the longest axis. A single piece is called a channer.

Chemical treatment. Control of unwanted vegetation through the use of chemicals.

Chiseling. Tillage with an implement having one or more soil-penetrating points that shatter or loosen hard, compacted layers to a depth below normal plow depth.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay depletions. Low-chroma zones having a low content of iron, manganese, and clay because of the chemical reduction of iron and manganese and the removal of iron, manganese, and clay. A type of redoximorphic depletion.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

Claypan. A slowly permeable soil horizon that contains much more clay than the horizons above it. A claypan is commonly hard when dry and plastic or stiff when wet.

Climax plant community. The stabilized plant community on a particular site. The plant cover reproduces itself and does not change so long as the environment remains the same.

Coarse textured soil. Sand or loamy sand.

Cobble (or cobblestone). A rounded or partly rounded fragment of rock 3 to 10 inches (7.6 to 25 centimeters) in diameter.

Cobbly soil material. Material that is 15 to 35 percent, by volume, rounded or partially rounded rock fragments 3 to 10 inches (7.6 to 25 centimeters) in diameter. Very cobbly soil material has 35 to 60 percent of these rock fragments, and extremely cobbly soil material has more than 60 percent.

Collapsed lake plan. A previously nearly level surface marking the floor of an extinct lake, filled in by well-sorted deposits from inflowing streams and underlain by glacial ice, now having the surface configuration of the underlying topography as a result of melting of the glacial ice.

Collapsed outwash plain. A previously broad, flat or gently sloping alluvial sheet of outwash deposited by meltwater streams and underlain by glacial ice, now having the surface configuration of the underlying topography as a result of melting of the glacial ice.

Colluvium. Soil material or rock fragments, or both, moved by creep, slide, or local wash and deposited at the base of steep slopes.

Complex slope. Irregular or variable slope. Planning or establishing terraces, diversions, and other water-control structures on a complex slope is difficult.

Complex, soil. A map unit of two or more kinds of soil

or miscellaneous areas in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas.

Concretions. Cemented bodies with crude internal symmetry organized around a point, a line, or a plane. They typically take the form of concentric layers visible to the naked eye. Calcium carbonate, iron oxide, and manganese oxide are common compounds making up concretions. If formed in place, concretions of iron oxide or manganese oxide are generally considered a type of redoximorphic concentration.

Conglomerate. A coarse grained, clastic rock composed of rounded or subangular rock fragments more than 2 millimeters in diameter. It commonly has a matrix of sand and finer textured material. Conglomerate is the consolidated equivalent of gravel.

Conservation cropping system. Growing crops in combination with needed cultural and management practices. In a good conservation cropping system, the soil-improving crops and practices more than offset the effects of the soil-depleting crops and practices. Cropping systems are needed on all tilled soils. Soil-improving practices in a conservation cropping system include the use of rotations that contain grasses and legumes and the return of crop residue to the soil. Other practices include the use of green manure crops of grasses and legumes, proper tillage, adequate fertilization, and weed and pest control.

Conservation tillage. A tillage system that does not invert the soil and that leaves a protective amount of crop residue on the surface throughout the year.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are:

Loose —noncoherent when dry or moist; does not hold together in a mass.

Friable —when moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm —when moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic —when wet, readily deformed by moderate pressure but can be pressed into a lump; will form a “wire” when rolled between thumb and forefinger.

Sticky —when wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

Hard —when dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft —when dry, breaks into powder or individual grains under very slight pressure.

Cemented —hard, little affected by moistening.

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Cotnol steetope. a r t o f
Thetwhiknres variesr

Crrostone.

C ved croe.

Depth, soil. Generally, the thickness of the soil over bedrock. Very deep soils are more than 60 inches deep over bedrock; deep soils, 40 to 60 inches; moderately deep, 20 to 40 inches; shallow, 10 to 20 inches; and very shallow, less than 10 inches.

Depth to rock (in tables). Bedrock is too near the surface for the specified use.

Diversion (or diversion terrace). A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

Divided-slope farming. A form of field stripcropping in which crops are grown in a systematic arrangement of two strips, or bands, across the slope to reduce the hazard of water erosion. One strip is in a close-growing crop that provides protection from erosion, and the other strip is in a crop that provides less protection from erosion. This practice is used where slopes are not long enough to permit a full stripcropping pattern to be used.

Drainage class (natural). Refers to the frequency and duration of wet periods under conditions similar to those under which the soil formed. Alterations of the water regime by human activities, either through drainage or irrigation, are not a consideration unless they have significantly changed the morphology of the soil. Seven classes of natural soil drainage are recognized:

Excessively drained —these soils have very high and high hydraulic conductivity and a low water-holding capacity. They are not suited to crop production unless irrigated.

Somewhat excessively drained —these soils have high hydraulic conductivity and a low water-holding capacity. Without irrigation, only a narrow range of crops can be grown and yields are low.

Well drained —these soils have an intermediate water-holding capacity. They retain optimum amounts of moisture, but they are not wet close enough to the surface or long enough during the growing season to adversely affect yields.

Moderately well drained —these soils are wet close enough to the surface or long enough that planting or harvesting operations or yields of some field crops are adversely affected unless a drainage system is installed. Moderately well drained soils commonly have a layer with low hydraulic conductivity, a wet layer relatively high in the profile, additions of water by seepage, or some combination of these.

Somewhat poorly drained —these soils are wet close enough to the surface or long enough that planting or harvesting operations or crop growth is markedly restricted unless a drainage system is installed. Somewhat poorly drained soils commonly have a layer with low hydraulic conductivity, a wet layer high in the profile, additions of water through seepage, or a combination of these.

Poorly drained —these soils commonly are so wet at or near the surface during a considerable part of the year that field crops cannot be grown under natural conditions. Poorly drained conditions are caused by a saturated zone, a layer with low hydraulic conductivity, seepage, or a combination of these.

Very poorly drained —these soils are wet to the surface most of the time. The wetness prevents the growth of important crops (except rice) unless a drainage system is installed.

Drainage, surface. Runoff, or surface flow of water, from an area.

Drainageway. An area of ground at a lower elevation than the surrounding ground and in which water collects and is drained to a closed depression or lake or to a drainageway at a lower elevation. A drainageway may or may not have distinctly incised channels at its upper reaches or throughout its course.

Draw. A small stream valley that generally is more open and has broader bottom land than a ravine or gulch.

Drift. A general term applied to all material transported by a glacier and deposited directly from the ice or by running water coming from the ice. Drift includes unstratified material (till) that forms moraines, and stratified glaciofluvial deposits that form outwash plains, eskers, kames, varves, and glaciolacustrine sediments. The term is generally applied to Pleistocene glacial deposits in areas that no longer contain glaciers.

Drumlin. A low, smooth, elongated oval hill, mound, or ridge of compact glacial till. The longer axis is parallel to the path of the glacier and commonly has a blunt nose pointing in the direction from which the ice approached.

Eluviation. The movement of material in true solution or colloidal suspension from one place to another within the soil. Soil horizons that have lost material through eluviation are eluvial; those that have received material are illuvial.

Endosaturation. A type of saturation of the soil in which all horizons between the upper boundary of saturation and a depth of 2 meters are saturated.

Eolian soil material. Earthy parent material accumulated through wind action; commonly refers to sandy material in dunes or to loess in blankets on the surface.

Ephemeral stream. A stream, or reach of a stream,

that flows only in direct response to precipitation. It receives no long-continued supply from melting snow or other source, and its channel is above the water table at all times.

Episaturation. A type of saturation indicating a perched water table in a soil in which saturated layers are underlain by one or more unsaturated layers within 2 meters of the surface.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of human or animal activities or of a catastrophe in nature, such as a fire, that exposes the surface.

Escarpment. A relatively continuous and steep slope or cliff breaking the general continuity of more gently sloping land surfaces and resulting from erosion or faulting. Synonym: scarp.

Esker. A narrow, winding ridge of stratified gravelly and sandy drift deposited by a stream flowing in a tunnel beneath a glacier.

Excess fines (in tables). Excess silt and clay in the soil. The soil does not provide a source of gravel or sand for construction purposes.

Excess lime (in tables). Excess carbonates in the soil that restrict the growth of some plants.

Excess salts (in tables). Excess water-soluble salts in the soil that restrict the growth of most plants.

Excess sodium (in tables). Excess exchangeable sodium in the soil. The resulting poor physical properties restrict the growth of plants.

Excess sulfur (in tables). Excessive amount of sulfur in the soil. The sulfur causes extreme acidity if the soil is drained, and the growth of most plants is restricted.

Fallow. Cropland left idle in order to restore productivity through accumulation of moisture. Summer fallow is common in regions of limited rainfall where cereal grain is grown. The soil is tilled for at least one growing season for weed control and decomposition of plant residue.

Fan terrace. A relict alluvial fan, no longer a site of active deposition, incised by younger and lower alluvial surfaces.

Fast intake (in tables). The rapid movement of water into the soil.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Fibric soil material (peat). The least decomposed of all organic soil material. Peat contains a large amount of well preserved fiber that is readily identifiable according to botanical origin. Peat has the lowest bulk density and the highest water content at saturation of all organic soil material.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the ovendry weight, after the gravitational, or free, water has drained away; the field moisture content 2 or 3 days after a soaking rain; also called normal field capacity, normal moisture capacity, or capillary capacity.

Fill slope. A sloping surface consisting of excavated soil material from a road cut. It commonly is on the downhill side of the road.

Fine textured soil. Sandy clay, silty clay, or clay.

Flaggy soil material. Material that is, by volume, 15 to 35 percent flagstones. Very flaggy soil material has 35 to 60 percent flagstones, and extremely flaggy soil material has more than 60 percent flagstones.

Flagstone. A thin fragment of sandstone, limestone, slate, shale, or (rarely) schist 6 to 15 inches (15 to 38 centimeters) long.

Flooding. The temporary covering of the soil surface by flowing water from any source.

Flooding frequency classes:

None —0 percent chance of flooding in any year.

Rare —0 to 5 percent chance of flooding in any year.

Occasional —5 to 50 percent chance of flooding in any year.

Frequent —more than 50 percent chance of flooding in any year.

Flooding duration classes:

Extremely brief —0.1 to 4.0 hours

Very brief —4 to 48 hours

Long —7 to 30 days

Very long —more than 30 days

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Fluvial. Of or pertaining to rivers; produced by river action, as a fluvial plain.

Foothill. A steeply sloping upland that has relief of as much as 1,000 feet (300 meters) and fringes a mountain range or high-plateau escarpment.

Foot slope. The bottom of a slope or the lower part of any elevated landform.
Forb. Any herbaceous plant not a grass or a sedge.
Forest cover. All trees and other woody plants (underbrush) covering the ground in a forest.
Forest type. A stand of trees similar in composition and development because of given physical and biological factors by which it may be differentiated from other stands.
Fragile (in tables). A soil that is easily damaged by use or disturbance.
Fragipan. A loamy, brittle subsurface horizon low in porosity and content of organic matter and low or moderate in clay but high in silt or very fine sand. A fragipan appears cemented and restricts roots. When dry, it is hard or very hard and has a higher bulk density than the horizon or horizons above. When moist, it tends to rupture suddenly under pressure rather than to deform slowly.
Frost action (in tables). Freezing and thawing of soil moisture. Frost action can damage roads, buildings and other structures, and plant roots.
Genesis, soil. The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.
Gilgai. Commonly, a succession of microbasins and microknolls in nearly level areas or of microvalleys and microridges parallel with the slope. Typically, the microrelief of clayey soils that shrink and swell considerably with changes in moisture content.
Glacial drift. Pulverized and other rock material transported by glacial ice and then deposited. Also, the sorted and unsorted material deposited by streams flowing from glaciers.
Glacial outwash. Gravel, sand, and silt, commonly stratified, deposited by glacial meltwater.
Glacial till. Unsorted, nonstratified glacial drift consisting of clay, silt, sand, and boulders transported and deposited by glacial ice.
Glaciofluvial deposits. Material moved by glaciers and subsequently sorted and deposited by streams flowing from the melting ice. The deposits are stratified and occur as kames, eskers, deltas, and outwash plains.
Glaciolacustrine deposits. Material ranging from fine clay to sand derived from glaciers and deposited in glacial lakes mainly by glacial meltwater. Many deposits are interbedded or laminated.
Gleyed soil. Soil that formed under poor drainage, resulting in the reduction of iron and other elements in the profile and in gray colors.
Graded stripcropping. Growing crops in strips that grade toward a protected waterway.
Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.
Gravel. Rounded or angular fragments of rock as much as 3 inches (2 millimeters to 7.6 centimeters) in diameter. An individual piece is a pebble.
Gravelly soil material. Material that is 15 to 35 percent, by volume, rounded or angular rock fragments, not prominently flattened, as much as 3 inches (7.6 centimeters) in diameter.
Green manure crop (agronomy). A soil-improving crop grown to be plowed under in an early stage of maturity or soon after maturity.
Ground water. Water filling all the unblocked pores of the material below the water table.
Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage. A gullied map unit is one that has numerous gullies.
Hard bedrock. Bedrock that cannot be excavated except by blasting or by the use of special equipment that is not commonly used in construction.
Hardpan. A hardened or cemented soil horizon, or layer. The soil material is sandy, loamy, or clayey and is cemented by iron oxide, silica, calcium carbonate, or other substance.
Hemic soil material (mucky peat). Organic soil material intermediate in degree of decomposition between the less decomposed fibric material and the more decomposed sapric material.
High-residue crops. Such crops as small grain and corn used for grain. If properly managed, residue from these crops can be used to control erosion until the next crop in the rotation is established. These crops return large amounts of organic matter to the soil.
Hill. A natural elevation of the land surface, rising as much as 1,000 feet above surrounding lowlands, commonly of limited summit area and having a well defined outline; hillsides generally have slopes of more than 15 percent. The distinction between a hill and a mountain is arbitrary and is dependent on local usage.
Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an uppercase letter

represents the major horizons. Numbers or lowercase letters that follow represent subdivisions of the major horizons. An explanation of the subdivisions is given in the "Soil Survey Manual." The major horizons of mineral soil are as follows:
O horizon —An organic layer of fresh and decaying plant residue.
A horizon —The mineral horizon at or near the surface in which an accumulation of humidified organic matter is mixed with the mineral material. Also, a plowed surface horizon, most of which was originally part of a B horizon.
E horizon —The mineral horizon in which the main feature is loss of silicate clay, iron, aluminum, or some combination of these.
B horizon —The mineral horizon below an A horizon. The B horizon is in part a layer of transition from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics, such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) prismatic or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these.
C horizon —The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the overlying soil material. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, an Arabic numeral, commonly a 2, precedes the letter C.
Cr horizon —Soft, consolidated bedrock beneath the soil.
R layer —Consolidated bedrock beneath the soil. The bedrock commonly underlies a C horizon, but it can be directly below an A or a B horizon.

Humus. The well decomposed, more or less stable part of the organic matter in mineral soils.

Hydric soil. Soils that formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions for the upper part.

Hydrologic soil groups. Refers to soils grouped according to their runoff potential. The soil properties that influence this potential are those that affect the minimum rate of water infiltration on a bare soil during periods after prolonged wetting when the soil is not frozen. These properties are depth to a seasonal high water table, the infiltration rate and permeability after prolonged wetting, and depth to a very slowly permeable layer. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff.

Igneous rock. Rock formed by solidification from a molten or partially molten state. Major varieties include plutonic and volcanic rock. Examples are andesite, basalt, and granite.

Illuviation. The movement of soil material from one horizon to another in the soil profile. Generally, material is removed from an upper horizon and deposited in a lower horizon.

Impervious soil. A soil through which water, air, or roots penetrate slowly or not at all. No soil is absolutely impervious to air and water all the time.

Increasers. Species in the climax vegetation that increase in amount as the more desirable plants are reduced by close grazing. Increasers commonly are the shorter plants and the less palatable to livestock.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Infiltration capacity. The maximum rate at which water can infiltrate into a soil under a given set of conditions.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Intermittent stream. A stream, or reach of a stream, that flows for prolonged periods only when it receives ground-water discharge or long, continued contributions from melting snow or other surface and shallow subsurface sources.

Invaders. On range, plants that encroach into an area and grow after the climax vegetation has been reduced by grazing. Generally, plants invade following disturbance of the surface.

Iron depletions. Low-chroma zones having a low content of iron and manganese oxide because of chemical reduction and removal, but having a clay content similar to that of the adjacent matrix. A type of redoximorphic depletion.

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are:
Basin —Water is applied rapidly to nearly level plains surrounded by levees or dikes.
Border —Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.
Controlled flooding —Water is released at

intervals from closely spaced field ditches and distributed uniformly over the field.

Corrugation —Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.

Drip (or trickle) —Water is applied slowly and under low pressure to the surface of the soil or into the soil through such applicators as emitters, porous tubing, or perforated pipe.

Furrow —Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.

Sprinkler —Water is sprayed over the soil surface through pipes or nozzles from a pressure system.

Subirrigation —Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.

Wild flooding —Water, released at high points, is allowed to flow onto an area without controlled distribution.

K Factor. Soil erodibility factor in the Universal Soil Loss Equation.

Kame. An irregular, short ridge or hill of stratified glacial drift.

Knoll. A small, low, rounded hill rising above adjacent landforms.

Lacustrine deposit. Material deposited in lake water and exposed when the water level is lowered or the elevation of the land is raised.

Lake plain. A surface marking the floor of an extinct lake, filled in by well sorted, stratified sediments.

Landslide. The rapid downhill movement of a mass of soil and loose rock, generally when wet or saturated. The speed and distance of movement, as well as the amount of soil and rock material, vary greatly.

Large stones (in tables). Rock fragments 3 inches (7.6 centimeters) or more across. Large stones adversely affect the specified use of the soil.

Leaching. The removal of soluble material from soil or other material by percolating water.

Lime. A soil material that consists of precipitated calcium or magnesium carbonate.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Loess. Fine grained material, dominantly of silt-sized particles, deposited by wind.

Low-residue crops. Such crops as corn used for silage, peas, beans, and potatoes. Residue from these crops is not adequate to control erosion until the next crop in the rotation is established. These crops return little organic matter to the soil.

Low strength. The soil is not strong enough to support loads.

Masses. Concentrations of substances in the soil matrix that do not have a clearly defined boundary with the surrounding soil material and cannot be removed as a discrete unit. Common compounds making up masses are calcium carbonate, gypsum or other soluble salts, iron oxide, and manganese oxide. Masses consisting of iron oxide or manganese oxide generally are considered a type of redoximorphic concentration.

Mechanical treatment. Use of mechanical equipment for seeding, brush management, and other management practices.

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Metamorphic rock. Rock of any origin altered in mineralogical composition, chemical composition, or structure by heat, pressure, and movement. Nearly all such rocks are crystalline.

Mineral soil. Soil that is mainly mineral material and low in organic material. Its bulk density is more than that of organic soil.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

Miscellaneous area. An area that has little or no natural soil and supports little or no vegetation.

Moderately coarse textured soil. Coarse sandy loam, sandy loam, or fine sandy loam.

Moderately fine textured soil. Clay loam, sandy clay loam, or silty clay loam.

Mollic epipedon. A thick, dark, humus-rich surface horizon (or horizons) that has high base saturation and pedogenic soil structure. It may include the upper part of the subsoil.

Moraine. An accumulation of earth, stones, and other debris deposited by a glacier. Some types are terminal, lateral, medial, and ground.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Mottling, soil. Irregular spots of different colors that vary in number and size. Descriptive terms are as follows: abundance—few, common, and many;

size—fine, medium, and coarse; and contrast—faint, distinct, and prominent. The size measurements are of the diameter along the greatest dimension. Fine indicates less than 5 millimeters (about 0.2 inch); medium, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and coarse, more than 15 millimeters (about 0.6 inch).

Mountain. A natural elevation of the land surface, rising more than 1,000 feet above surrounding lowlands, commonly of restricted summit area (relative to a plateau) and generally having steep sides. A mountain can occur as a single, isolated mass or in a group forming a chain or range.

Muck. Dark, finely divided, well decomposed organic soil material. (See Sapric soil material.)

Mudstone. A blocky or massive, fine-grained sedimentary rock that consists of a mixture of clay, silt, and sand particles, the proportion of which vary from place to place.

Munsell notation. A designation of color by degrees of three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color with hue of 10YR, value of 6, and chroma of 4.

Natric horizon. A special kind of argillic horizon that contains enough exchangeable sodium to have an adverse effect on the physical condition of the subsoil.

Neutral soil. A soil having a pH value of 6.6 to 7.3. (See Reaction, soil.)

Nodules. Cemented bodies lacking visible internal structure. Calcium carbonate, iron oxide, and manganese oxide are common compounds making up nodules. If formed in place, nodules of iron

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pH value. A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Piping (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from semisolid to plastic.

Plateau. An extensive upland mass with relatively flat summit area that is considerably elevated (more than 100 meters) above adjacent lowlands and separated from them on one or more sides by escarpments.

Plowpan. A compacted layer formed in the soil directly below the plowed layer.

Ponding. Standing water on soils in closed depressions. Unless the soils are artificially drained, the water can be removed only by percolation or evapotranspiration.

Very brief —less than 2 days
Brief —2 to 7 days
Long —7 to 30 days
Very long —more than 30 days

Poor filter (in tables). Because of rapid or very rapid permeability, the soil may not adequately filter effluent from a waste disposal system.

Poorly graded. Refers to a coarse grained soil or soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles, density can be increased only slightly by compaction.

Poor outlets (in tables). Refers to areas where surface or subsurface drainage outlets are difficult or expensive to install.

Porcelanite (scoria). Shale and clay that are fused as a result of their proximity to a burning coal vein.

Potential native plant community. See Climax plant community.

Potential rooting depth (effective rooting depth). Depth to which roots could penetrate if the content of moisture in the soil were adequate. The soil has no properties restricting the penetration of roots to this depth.

Prescribed burning. Deliberately burning an area for specific management purposes, under the appropriate conditions of weather and soil moisture and at the proper time of day.

Productivity, soil. The capability of a soil for producing a specified plant or sequence of plants under specific management.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Proper grazing use. Grazing at an intensity that maintains enough cover to protect the soil and maintain or improve the quantity and quality of the desirable vegetation. This practice increases the vigor and reproduction capacity of the key plants and promotes the accumulation of litter and mulch necessary to conserve soil and water.

Range condition. The present composition of the plant community on a range site in relation to the potential natural plant community for that site. Range condition is expressed as excellent, good, fair, or poor on the basis of how much the present plant community has departed from the potential.

Rangeland. Land on which the potential natural vegetation is predominantly grasses, grasslike plants, forbs, or shrubs suitable for grazing or browsing. It includes natural grasslands, savannas, many wetlands, some deserts, tundras, and areas that support certain forb and shrub communities.

Range site. An area of rangeland where climate, soil, and relief are sufficiently uniform to produce a distinct natural plant community. A range site is the product of all the environmental factors responsible for its development. It is typified by an association of species that differ from those on other range sites in kind or proportion of species or total production.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degrees of acidity or alkalinity, expressed as pH values, are:

Ultra acid —less than 3.5
Extremely acid —3.5 to 4.4
Very strongly acid —4.5 to 5.0
Strongly acid —5.1 to 5.5
Moderately acid —5.6 to 6.0
Slightly acid —6.1 to 6.5
Neutral —6.6 to 7.3
Slightly alkaline —7.4 to 7.8
Moderately alkaline —7.9 to 8.4
Strongly alkaline —8.5 to 9.0
Very strongly alkaline —9.1 and higher

Red beds. Sedimentary strata that are mainly red and are made up largely of sandstone and shale.

Redoximorphic concentrations. Nodules, concretions, soft masses, pore linings, and other features resulting from the accumulation of iron or manganese oxide. An indication of chemical reduction and oxidation resulting from saturation.

Redoximorphic depletions. Low-chroma (2 or less) zones from which iron and manganese oxide or a combination of iron and manganese oxide and clay has been removed. These zones are indications of the chemical reduction of iron resulting from saturation.

Redoximorphic features. Redoximorphic concentrations, redoximorphic depletions, reduced matrices, a positive reaction to alpha, alpha-dipyridyl, and other features indicating the chemical reduction and oxidation of iron and manganese compounds resulting from saturation.

Reduced matrix. A soil matrix that has low chroma in situ because of chemically reduced iron (Fe II). The chemical reduction results from nearly continuous wetness. The matrix undergoes a change in hue or chroma within 30 minutes after exposure to air as the iron is oxidized (Fe III). A type of redoximorphic feature.

Regolith. The unconsolidated mantle of weathered rock and soil material on the earth's surface; the loose earth material above the solid rock.

Relief. The elevations or inequalities of a land surface, considered collectively.

Residuum (residual soil material). Unconsolidated, weathered or partly weathered mineral material that accumulated as consolidated rock disintegrated in place.

Retrogression. The process by which rangeland vegetation changes significantly from the natural potential plant community. syn., range deterioration, site deterioration.

Revised Universal Soil Loss Equation (RUSLE). An erosion model designed to predict the long term average soil loss carried by runoff from specific field slopes in specified cropping and management systems.

Rill. A steep-sided channel resulting from accelerated erosion. A rill generally is a few inches deep and not wide enough to be an obstacle to farm machinery.

Rock fragments. Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

Rock outcrop. Exposures of bare bedrock other than lava flows and rock-lined pits. Most rock outcrops are hard rock.

Root shearing. The cutting, tearing, and disruption of plant roots by the hooves of animals during grazing when the soil is wet and soft.

Rooting depth (in tables). Shallow root zone. The soil is shallow over a layer that greatly restricts roots.

Root zone. The part of the soil that can be penetrated by plant roots.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Saline seep. Areas of nonirrigated soils with restricted drainage, where salinity has recently developed.

Saline soil. A soil containing soluble salts in an amount that impairs growth of plants. A saline soil does not contain excess exchangeable sodium.

Saline-sodic soil. A soil containing a combination of soluble salts and exchangeable sodium sufficient to interfere with the growth of plants.

Salty water (in tables). Water that is too salty for consumption by livestock.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sandstone. Sedimentary rock containing dominantly sand-sized particles.

Sapric soil material (muck). The most highly decomposed of all organic soil material. Muck has the least amount of plant fiber, the highest bulk density, and the lowest water content at saturation of all organic soil material.

Saturation. Wetness characterized by zero or positive pressure of the soil water. Under conditions of saturation, the water will flow from the soil matrix into an unlined auger hole.

Scarification. The act of abrading, scratching, loosening, crushing, or modifying the surface to increase water absorption or to provide a more tillable soil.

Sedimentary rock. Rock made up of particles deposited from suspension in water. The chief kinds of sedimentary rock are conglomerate, formed from gravel; sandstone, formed from sand; shale, formed from clay; and limestone, formed from soft masses of calcium carbonate. There are many intermediate types. Some wind-deposited sand is consolidated into sandstone.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Sequum. A sequence consisting of an illuvial horizon and the overlying eluvial horizon. (See Eluviation.)

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Shale. Sedimentary rock formed by the hardening of a clay deposit.

Sheet erosion. The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and surface runoff.

Shoulder slope. The uppermost inclined surface at the top of a hillside. It is the transition zone from the back slope to the summit of a hill or mountain. The surface is dominantly convex in profile and erosional in origin.

Shrink-swell (in tables). The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Siltstone. Sedimentary rock made up of dominantly silt-sized particles.

Similar soils. Soils that share limits of diagnostic criteria, behave and perform in a similar manner, and have similar conservation needs or management requirements for the major land uses in the survey area.

Slickensides. Polished and grooved surfaces produced by one mass sliding past another. In soils, slickensides may occur at the bases of slip surfaces on the steeper slopes; on faces of blocks, prisms, and columns; and in swelling clayey soils, where there is marked change in moisture content.

Slick spot. A small area of soil having a puddled, crusted, or smooth surface and an excess of exchangeable sodium. The soil generally is silty or clayey, is slippery when wet, and is low in productivity.

Slippage (in tables). Soil mass susceptible to movement downslope when loaded, excavated, or wet.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance. In this survey, classes for simple slopes are as follows:

Level —0 to 1 percent
Level and nearly level —0 to 3 percent
Nearly level —1 to 3 percent
Gently sloping or undulating —3 to 6 percent
Moderately sloping or gently rolling —6 to 9 percent
Strongly sloping or rolling —9 to 15 percent
Moderately steep or hilly —15 to 25 percent
Steep —25 to 35 percent
Very steep —More than 35 percent

Slope (in tables). Slope is great enough that special practices are required to ensure satisfactory performance of the soil for a specific use.

Slow intake (in tables). The slow movement of water into the soil.

Small stones (in tables). Rock fragments less than 3 inches (7.6 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

Sodic (alkali) soil. A soil having so high a degree of alkalinity (pH 8.5 or higher) or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that plant growth is restricted.

Sodicity. The degree to which a soil is affected by exchangeable sodium. Sodicity is expressed as a sodium adsorption ratio (SAR) of a saturation extract, or the ratio of the Na concentration divided by the square root of one-half of the Ca + Mg concentration. The degrees of sodicity and their respective ratios are:

Slight —less than 13:1
Moderate —13-30:1
Strong —more than 30:1

Soft bedrock. Bedrock that can be excavated with trenching machines, backhoes, small rippers, and other equipment commonly used in construction.

Soil. A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil depth class.

Very shallow —less than 10 inches to bedrock
Shallow —10 to 20 inches to bedrock
Moderately deep —20 to 40 inches to bedrock
Deep —40 to 60 inches to bedrock
Very deep —greater than 60 inches to bedrock

Soil separates. Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes, in millimeters, of separates recognized in the United States are as follows:

Very coarse sand —2.0 to 1.0
Coarse sand —1.0 to 0.5
Medium sand —0.5 to 0.25
Fine sand —0.25 to 0.10
Very fine sand —0.10 to 0.05
Silt —0.05 to 0.002
Clay —less than 0.002

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A, E, and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the material below the solum. The living roots and plant and animal activities are largely confined to the solum.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter if rounded or 15 to 24 inches (38 to 60 centimeters) in length if flat.

Stony. Refers to a soil containing stones in numbers that interfere with or prevent tillage.

Stripcropping. Growing crops in a systematic arrangement of strips or bands that provide vegetative barriers to wind erosion and water erosion.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—platy (laminated), prismatic (vertical axis of aggregates longer than horizontal), columnar (prisms with rounded tops), blocky (angular or subangular), and granular. Structureless soils are either single grain (each grain by itself, as in dune sand) or massive (the particles adhering without any regular cleavage, as in many hardpans).

Stubble mulch. Stubble or other crop residue left on the soil or partly worked into the soil. It protects the soil from wind erosion and water erosion after harvest, during preparation of a seedbed for the next crop, and during the early growing period of the new crop.

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Subsoiling. Tilling a soil below normal plow depth, ordinarily to shatter a hardpan or claypan.

Substratum. The part of the soil below the solum.

Subsurface layer. Technically, the E horizon. Generally refers to a leached horizon lighter in color and lower in content of organic matter than the overlying surface layer.

Summer fallow. The tillage of uncropped land during the summer to control weeds and allow storage of moisture in the soil for the growth of a later crop. A practice common in semiarid regions, where annual precipitation is not enough to produce a crop every year. Summer fallow is frequently practiced before planting winter grain.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the “plow layer,” or the “Ap horizon.”

Surface soil. The A, E, AB, and EB horizons, considered collectively. It includes all subdivisions of these horizons.

Talus. Fragments of rock and other soil material accumulated by gravity at the foot of cliffs or steep slopes.

Taxadjuncts. Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use and behavior. Soils are recognized as taxadjuncts only when one or more of their characteristics are slightly outside the range defined for the family of the series for which the soils are named.

Terminal moraine. A belt of thick glacial drift that generally marks the termination of important glacial advances.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet. A terrace in a field generally is built so that the field can be farmed. A terrace intended mainly for drainage has a deep channel that is maintained in permanent sod.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay, and clay. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer (in tables). Otherwise suitable soil material that is too thin for the specified use.

Till plain. An extensive area of nearly level to undulating soils underlain by glacial till.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Toe slope. The lower gentle slope of a hillside. The lowest part of a foot slope.

Too arid (in tables). The soil is dry most of the time, and vegetation is difficult to establish.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Toxicity (in tables). Excessive amount of toxic substances, such as sodium or sulfur, that severely hinder establishment of vegetation or severely restrict plant growth.

Trace elements. Chemical elements, for example, zinc, cobalt, manganese, copper, and iron, in soils in extremely small amounts. They are essential to plant growth.

Universal Soil Loss Equation (USLE). An equation used to design water erosion control systems: **A—RKLSPC** where **A** is average annual soil loss in tons per acre per year; **R** is the rainfall factor; **K** is the soil erodibility factor; **L** is the length of slope; **S** is the percent slope; **P** is the conservation practice factor; and **C** is the cropping and management factor.

Unstable fill (in tables). Risk of caving or sloughing on banks of fill material.

Upland. Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Valley. An elongated depressional area primarily developed by stream action.

Valley fill. In glaciated regions, material deposited in stream valleys by glacial meltwater. In nonglaciated regions, alluvium deposited by heavily loaded streams.

Variegation. Refers to patterns of contrasting colors assumed to be inherited from the parent material rather than to be the result of poor drainage.

Varve. A sedimentary layer or a lamina or sequence of laminae deposited in a body of still water within a year. Specifically, a thin pair of graded glaciolacustrine layers seasonally deposited, usually by meltwater streams, in a glacial lake or other body of still water in front of a glacier.

Very deep soil. A soil that is more than 60 inches deep over bedrock or to other material that restricts the penetration of plant rows.

Very shallow soil. A soil that is less than 10 inches deep over bedrock or to other material that restricts the penetration of plant roots.

Water table. The upper surface of groundwater or that level below the surface at which the soil is saturated with water. For soil survey purposes, the depth at which the water table is observed is within 60 inches from the surface.

- **Apparent** —Level at which water stands in a freshly dug, unlined borehole after it has adequate time for adjustments in the surrounding soil.
- **Perched** —A saturated soil zone above an unsaturated layer in the soil.
- **Artesian** —A water table under hydrostatic head beneath an impermeable layer.
- **Seasonal** —A water table within 60 inches of the surface during the growing season.

Weathering. All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.

Well graded. Refers to soil material consisting of coarse grained particles that are well distributed over a wide range in size or diameter. Such soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

Wilting point (or permanent wilting point). The moisture content of soil, on an ovendry basis, at which a plant (specifically a sunflower) wilts so much that it does not recover when placed in a humid, dark chamber.

Windsculptured. A land surface of which its form has been changed by action of the wind.

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